Standard Schedule

For

Grading

Cities and Towns of the United States

With Reference

To Their Fire Defenses and Physical Conditions

National Board of Fire Underwriters

New York

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Adopted, December 14, 1916

Edition of 1922

INTRODUCTORY.

The Grading Schedule is based upon the plan of assigning to the various features of fire defense found in cities of the United States, points of deficiency depending upon the extent of variance from standards formulated from a study of conditions in more than 500 cities; the natural and structural conditions which increase the general hazard of cities, and the lack of laws or of their enforcement for the control of unsatisfactory conditions, are graded in the same way. The sum of the maximum points of deficiency totals 5,000 and is divided in accordance with the relative values of the features considered as given below.

RELATIVE VALUES.

	Points
Water Supply	**1,700**
Fire Department	**1,500**
Fire Alarm	**550**
Police	**50**
Building Laws	**200**
Hazards	**300**
Structural Conditions	**700**
	5,000

It is recognized that climatic conditions affect fire losses, by reason of the frequency of fires due to the heating hazard, by retarding the response of fire apparatus, by hampering effective fire fighting during cold weather and storms, by the increase in combustibility due to hot and dry weather, and by the greater probability of fires spreading at time of high winds. Also that earthquakes, tornadoes, hurricanes, cyclones, blizzards, floods and other unusual conditions have an influence on the conflagration hazard. These elements are to a greater or less degree common to the whole country, and therefore no deficiency is considered in the Schedule for normal climatic conditions. Some sections of

the country, however, are subject to abnormal climatic conditions, and to cities in these sections, a super-deficiency is applied, as given on pages 77 and 78. This super-deficiency is to be added to the deficiency determined by the application of the Schedule proper.

A good water supply in connection with a poor fire department, or *vice versa,* is of less value than if both are good. In recognition of this, a modification of the better one of the two features is made, in accordance with the plan given on page 80, provided the divergence exceeds the equivalent of three classes.

The subjects considered in grading the various features are given on pages 4 to 8 and the details of grading on the pages following; the total of the points of deficiency is used in determining the class of the city or town graded, in accordance with the plan given on page 9.

In determining the points of deficiency to be applied to many of the items, it appears reasonable to use a graduated scale of points depending upon the per cent. of deficiency, with a lesser increment for the first 30 per cent. than for the remainder; that is, a deficiency of 10 per cent. in good or moderately good conditions has less actual effect than where conditions are poor. Such a scale has been prepared and is given below; either the full scale, a multiple or a fractional part thereof is used, depending upon the relative weight or importance of the item under consideration.

To save space, this Scale is printed in full on page 3, and reference is made to it under each item to which it applies.

In all items, the total required quantity or the total required number must be used as the basis in figuring the percentage of deficiency, except that under Water Supply, if there is a deficiency under Item 6*b,* the quantity available on which this deficiency was obtained shall be used as a basis in figuring the percentage of deficiency of Items 7 to 16, inclusive, except for the Item on which the inadequacy occurs, in which case the total required quantity will be used. In Items 1, 2, 12, 15, 17, 20, 21, 23, and 26 of Fire Department the deficiency shall be on the basis of existing companies.

DEFICIENCY SCALE.

(Points of deficiency corresponding to per cent. deficient.)

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	0	10	25	45	67	90	112	134	156	178	200
1%	1	12	27	47	70	92	114	136	158	180	POINTS
2%	2	13	29	50	72	94	116	138	160	182	
3%	3	15	31	52	74	97	119	141	163	185	
4%	4	16	33	54	77	99	121	143	165	187	
5%	5	18	35	57	79	101	123	145	167	189	
6%	6	19	37	59	81	103	125	147	169	191	
7%	7	21	39	61	83	105	127	149	171	194	
8%	8	22	41	63	85	108	130	152	174	196	
9%	9	24	43	65	88	110	132	154	176	198	

Where quantity or numbers cannot be used as the basis, as in Items 2, 7, 10, 11 and 17 of Water Supply and Items 3, 23, 25, 28, 29 and 31 of Fire Department, the degree of deficiency shall be graded approximately as follows: Slight, 10 per cent.; moderate, 25 per cent.; considerable, 50 per cent.; serious, 75 per cent., and total, 100 per cent. In considering the degree of such unreliability, the size of the community shall be considered; conditions which in a city would be considered as serious would in a village be only moderate or considerable, because of the less general probability of a fire occurring.

Under certain items definite points of deficiency are assigned to certain conditions described as "Fair," "Poor," etc. When conditions found are judged to be intermediate between those listed, or when the minimum points specified appear not justified, points may be applied in proportion to the degree of deficiency.

Modifications of the Schedule issued March 1, 1921, have been incorporated in this 1922 edition. In addition, some changes in the wording have been made to clarify its meaning or to conform with recently adopted regulations, particularly as noted under Fire Alarm System; none of these will materially affect previous gradings.

SUBJECTS CONSIDERED IN THE SCHEDULE.

Water Supply.

Item

1. Appointment of Employees.
2. Efficiency of Executive.
3. Records and Plans.
4. Emergency Repair Provisions.
5. Receipt of Alarms by Department.
6. Normal Adequacy of Entire System.
7. Reliability of Source of Supply.
8. Sufficiency of Reserve Pump Capacity.
9. Sufficiency of Reserve Boiler Capacity.
10. Condition and Arrangement of Equipment.
11. Fuel Supply or Electric Power.
12. Construction of Pumping Station.
13. Fire Protection of Pumping Station.
14. Hazards of Pumping Station.
15. Exposures to Pumping Station.
16. Reliability of Supply Mains as Affecting Adequacy.
17. Reliability of Installation of Supply Mains.
18. Completeness of Arterial System.
19. Reliability of Installation of Mains.
20. Effect of Small Mains in the High Value District Considered.
21. 4-inch Mains in System.
22. Dead Ends—4- and 6-inch Mains.
23. Completeness of Gridiron of 6-inch Mains.
24. Quality and Condition of Pipe.
25. Electrolysis.
26. Spacing of Gate Valves.
27. Condition of Gate Valves.
28. Distribution of Hydrants in the High Value District Considered.
29. Ditto in Residential Districts.
30. Condition of Hydrants.
31. Size and Design of Hydrants.
32. Valves on Hydrant Branch.

Fire Department.

Item

1. Number of Officers.
2. Number of Operators.
3. Qualifications of Chief Officers.
4. Tenure of Office of Chief.
5. Appointment and Tenure of Office of Officers.
6. Enlistment Requirements.
7. Retirement Requirements.
8. Number of Hose or Engine Companies (Apparatus).
9. Number of Ladder Companies (Apparatus).
10. Distribution of Companies.
11. Total Required Manual Strength of Department.
12. Manual Strength of Existing Companies in the High Value District Considered.
13. Engine Capacity.
14. Reserve Engines.
15. Condition of Engines and Hose Wagons.
16. Fire Boats.
17. Powerful Stream Appliances.
18. Chemical Equipment.
19. Reserve Hose Wagons.
20. Amount of Hose.
21. Hose Larger than 2½-inch.
22. Condition of Hose.
23. Minor Equipment.
24. Fuel.
25. Repair Facilities.
26. Horses or Motive Power.
27. Suitability of Fire Stations.
28. Discipline.
29. Drills and Training.
30. Responding to Alarms.
31. Fire Methods.
32. Conditions Affecting Fire Department Operations.
33. Building Inspections.
34. Records of Fires, etc.

Introductory.

Fire Alarm.

Item

1. Qualifications of Management.
2. Adequacy of Maintenance Force.
3. Operators.
4. Headquarters Building.
5. Apparatus at Headquarters.
6. Circuit Protection.
7. Batteries.
8. Circuits Underground.
9. Condition and Material of Circuits.
10. Circuits Near High-Potential.
11. Open or Grounded Circuits.
12. Overloaded Circuits.
13. Alarms to Fire Stations.
14. Condition of Inside Wiring.
15. Type of Boxes.
16. Conspicuousness and Accessibility of Boxes.
17. Condition of Boxes.
18. Distribution of Boxes.
19. Tests and Records.
20. Speed of Alarms.
21. Fire Department Telephone System.
22. Transmission of Telephone Alarms.
23. Provisions for Transmitting Telephone Fire Alarms from the Telephone Exchange.
24. Method of Handling Telephone Fire Alarms at the Telephone Exchange.

Police.

1. Co-operation with Fire Department.
2. Patrol Wagons.
3. Signalling System.
4. Co-operation with Building Department.

Introductory.

Building Laws.

Item

1. Fire Limits.
2. Construction and Protection of Buildings.
3. Wooden Shingle Roofs.
4. Records.

Note.—Lack of Enforcement is Considered Equivalent to Absence of Law.

Hazards.

Electric Lighting and Heating:

1. Laws.
2. New Inside Work.
3. Old Inside Work.

Oil Lighting and Heating:

4. Laws.
5. Condition.

Gas Lighting and Heating:

6. Laws.
7. Condition.

Explosives and Inflammables:

8. Laws and Enforcement.
9. Records.

Introductory.

Structural Conditions.

Item

1. Area of District or of Largest Subdivision Made by Fire Breaks or Barriers.
2. Street Widths.
3. Accessibility of Block Interior.
4. Per Cent. of Area in Streets and Open Spaces.
5. Per Cent. of Block Area Built Upon.
6. Heights of Buildings Other than Fireproof.
7. Large and Excessive Areas Other than Frame.
8. Deficient Party and Fire Walls.
9. Unprotected Floor Openings.
10. Unprotected Exposed Openings.
11. Frame Buildings.
12. Permanent Awnings and non-fire-resistive roof coverings.
13. Conflagration Breeding Blocks.
14. Exposures to District.

Credits.

21. Superior Construction and Protection.
22. Fire Engine Capacity, where Water Supply at Direct Hydrant Streams is Adequate.
23. High Pressure Fire System.

Note.—Items apply only to the high value district considered.

Additional Deficiencies.

Climatic Conditions:

1. High Winds.
2. Excessive Snowfall.
3. Severe Cold Weather.
4. Hot Dry Weather.
5. Unusual or Exceptional Conditions.

Divergence in Grading of Fire Department and Water Supply.

CLASSIFICATION OF CITIES AND TOWNS BASED ON THE RELATIVE NUMBER OF POINTS OF DEFICIENCY IN FIRE DEFENSES AND PHYSICAL CONDITIONS.

A First Class City or Town
is one receiving 0 to 500 points of deficiency

A Second Class City or Town
is one receiving 501 to 1,000 points of deficiency

A Third Class City or Town
is one receiving 1,001 to 1,500 points of deficiency

A Fourth Class City or Town
is one receiving 1,501 to 2,000 points of deficiency

A Fifth Class City or Town
is one receiving 2,001 to 2,500 points of deficiency

A Sixth Class City or Town
is one receiving 2,501 to 3,000 points of deficiency

A Seventh Class City or Town
is one receiving 3,001 to 3,500 points of deficiency

An Eighth Class City or Town
is one receiving 3,501 to 4,000 points of deficiency

A Ninth Class City or Town
is one receiving 4,001 to 4,500 points of deficiency

A Tenth Class City or Town
is one receiving more than 4,500 points; or without a Water Supply and having a Fire Department grading 10th class; or with no fire protection.

STANDARD GRADING SCHEDULE

WATER SUPPLY.

It is recognized that a so-called gravity system, *i. e.*, one delivering supply directly to the city from the source without the use of pumps, is preferable from a fire protection standpoint, but a well designed and properly safeguarded direct pressure system, such as the high pressure fire systems of some of our large cities, so nearly approaches the gravity system in adequacy and reliability that no distinction is made between the two types.

In general, reliable fire protection requires such duplication of all parts of a water system that with such parts out of service as may reasonably be expected to be inoperative, the system will still be able to furnish the required fire flow. The introduction of storage, either elevated and supplying the distribution system or for suction supply, offsets to a greater or less degree the need of duplication in various parts of a system, the value of the storage depending upon its amount and location; as affecting reliability of supply, it appears to be a reasonable assumption that a storage sufficient to provide fire flow for 10 hours during a period of 5 days of maximum consumption is sufficient to permit the making of most of the repairs, alterations or additions incident to the operation of a water supply system, and this assumption will be used as a basis in determining the extent of deficiency under Items 8, 9 and 16. The amount of storage and the probable time required to make repairs shall be taken into consideration in deciding on the degree of unreliability of Items 7, 10 to 15 and 17. In general all storage lessens the requirements of those parts of the system through which supply has already passed. In no case can a rate in excess of the actual capacity of the mains from the storage be considered. Where storage fluctuates as much as 10 per cent. during the 24 hours, the minimum storage maintained must be used in the calculations. Owing to the decrease in pressure when water is drawn down in standpipes, only the capacity of the top 25 feet can be considered as storage, unless situated

on elevated ground and supply is to fire engines. Capacity of pumps shall be considered on basis of present capacity, with proper allowance for loss due to condition.

The ability to utilize emergency supplies through connections to another system, or from a separate source or storage not normally used, must be considered in charging for deficiencies in the system under consideration, and credit given for the supply thus available at such pressures as may be required for adequate protection. These supplies are divided into two groups: 1st, Those owned or controlled by the same management as the system. Full credit may be given under items of reliability (Items 7 to 17, inclusive), where the supply comes in automatically or where definite arrangements are made for quickly drawing from the emergency supplies, with detail plans on file, showing locations of gates and pipe lines. If no such arrangements and plans, or the emergency supplies, because of pollution, would be used only after conflagration conditions existed, credit shall be given for only ½ the points which these supplies decrease the deficiency of the system. Under adequacy (Item 6) the above credits will be made only where the emergency supply can be turned in within 30 minutes, unless sufficient storage is available to maintain adequate supply for a period of 2 hours.

2nd. Those under outside control where no contract agreement provides for their utilization by employees of the system. These shall be applied only for Items 7 to 17, inclusive, under which credit shall be given for ⅓ the points which the quantity available from these supplies decrease the deficiency of the system.

Where a system is supplied from 2 or more sources of supply works, or where there are 2 or more systems serving the same area, the source or system furnishing the maximum protection shall be considered as the primary one; if one system is available at direct hydrant stream pressure, the low pressure system may be considered, in addition to the domestic consumption which it supplies, only up to the amount of engine capacity available plus ⅓ the required fire flow, assumed as waste at fires. Application shall be made to the primary source or system, the deficiency of

which to be offset in whole or in part in any individual item by the additional protection afforded by the secondary source or system. Where the system graded covers only the district considered, Items 21 to 32, inclusive, must be based in whole or in part on conditions in the other system.

Supply from fire boats delivered through pipe lines which are drained during a part of the year shall not be considered as emergency supply or as a second system in offsetting deficiencies in fire protection furnished by a domestic water system.

Where a water system exists, and canals, streams, ponds, wells and cisterns make suction supply for engines also available, the suction supply may be considered in its ability to offset the deficiency in the various items where it would apply, but not in excess of the engine capacity available; in general, the only items affected will be Nos. 20, 28 and 29. Where no water system exists, such suction supply shall not be graded under Water Supply, a full deficiency of 1,700 points being allowed; the availability of such supplies shall be considered in estimating the value of engine capacity and hose.

In grading cities where High Pressure Fire Systems furnish protection to only a part of the district considered, separate gradings shall be made for the part thus protected and for the part not protected.

The requirements given hereinafter are based in part upon the assumption that the maximum daily consumption is 50 per cent. in excess of the average, but in all cases of application the actual average consumption for the year previous shall be taken as the average consumption, and the maximum consumption for any 24 hours in the past 3 years taken as the maximum consumption, unless conditions have so changed that this maximum will not occur again.

In estimating required fire flow, an allowance is made for probable loss from broken connections incident to a large fire. Including this allowance, the total fire flow which should be available is approximately as given in the table on page 14 (based on formula $G = 1{,}020 \sqrt{P} (1 - .01 \sqrt{P})$, where $G =$ gallons per minute and $P =$ population in thousands); but in all

cases consideration must be given to the structural conditions as found in the city and also to the number of companies in the fire department and the amount of outside aid that would be called upon in case of a serious fire. The ratio of the total engine capacity to the fire flow required will be approximately as 2 to 3.

TABLE OF REQUIRED FIRE FLOW.

Population.	Required Fire Flow, Gallons per Minute for Average City.	Population.	Required Fire Flow, Gallons per Minute for Average City.
1,000	1,000	28,000	5,000
2,000	1,500	40,000	6,000
4,000	2,000	60,000	7,000
6,000	2,500	80,000	8,000
10,000	3,000	100,000	9,000
13,000	3,500	125,000	10,000
17,000	4,000	150,000	11,000
22,000	4,500	200,000	12,000

Over 200,000 population, 12,000 gallons a minute, with 2,000 to 8,000 gallons additional for a second fire.

In Residential Districts.—The required fire flow depends upon the character and congestion of the buildings. Sections where buildings are small and of low height and with about 1/3 the lots in a block built upon require not less than 500 gallons a minute; with larger or higher buildings up to 1,000 gallons is required, and where the district is closely built, or buildings approach the dimension of hotels or high value residences, 1,500 to 3,000 gallons is required, with up to 6,000 gallons in densely built sections of 3-story buildings.

In grading the adequacy of the water supply two features are considered:

1st. The ability to deliver fire flow at any pressure down to 20 pounds, except that a minimum of 10 pounds is permissible in districts having no deficiency in Items 28 and 31 and having all hydrants provided with at least one steamer outlet; this is a measure of the ultimate capacity of the system to maintain supply of some sort under conflagration conditions and with the system in full operation, and application is made on this basis for the available flow at 20 or 10 pounds under Items 6*a* and *b*.

2nd. The ability to deliver this fire flow or a part thereof at pressures permitting streams direct from hydrants; these pressures are assumed at 75 pounds or more in high value districts, depending upon the static pressure available, the heights of buildings and the amount of engine capacity in service; 60 pounds where not more than 10 buildings exceed 3 stories and in closely built residential districts, and 50 pounds in village mercantile districts where buildings do not exceed 2 stories and in thinly built residential sections. Two-thirds the fire flow available at these pressures, in excess of the engine capacity available, may be credited under Item 13*a*, Fire Department, as offsetting, in whole or in part, any deficiency in engine capacity. The inability to deliver even a portion of the supply at pressures better than that for engines is recognized in Item 6*c*.

In grading other items of Water Supply, the fire flow is considered as available at 20 pounds, unless credit has been given under Item 13, Fire Department, for direct hydrant stream supply. In this case, Items 8, 9, 16, 18, 21, 22, 23 and 28 shall be considered with respect to the ability to deliver water at direct hydrant stream pressure; except that if fire engines are available gradings of Items 8 and 16 may be on the basis of quantities obtainable at 20 pounds, but not to exceed a fire flow, at times of maximum domestic consumption, equal to ⅓ the fire flow required, assumed as waste, plus the available engine capacity.

1. APPOINTMENT.—Employees on municipal systems to be under adequate civil service rules, properly administered, with tenure of office secure. Long tenure of office and an efficient organization considered the equivalent.

Appointments not under civil service for indefinite terms:

Use 1/10 Deficiency Scale.

2. CHIEF EXECUTIVE (Superintendent or Chief Engineer) to be qualified by experience, preferably supplemented by education, to fill the office efficiently.

Points

Not qualified:

Use 1/10 Deficiency Scale.

3. RECORDS AND PLANS of the physical structures and operation of the system to be complete, in convenient form, safely filed, in duplicate, indexed and up to date.

Records or plans:

a. Slightly incomplete.	**5**
**b. Moderately " **	**10**
**c. Very " **	**25**

4. EMERGENCY CREWS shall either be on duty at all times or quickly available; an emergency wagon, preferably motor-driven, loaded with necessary tools, shall be provided. At least one responsible employee familiar with the system shall respond to fire alarms in mercantile districts and to second alarms elsewhere.

Emergency provisions:

a. Fair.	**5**
b. Poor.	**15**

5. ALARMS OF FIRE shall sound in some quarters of the department, and in pumping stations of direct pumping systems. Where pressures are raised to furnish hydrant streams, or pumps are started or emergency valves opened to furnish fire service, duplicate alarm circuits shall be provided as to fire stations; telephone service shall be considered as 25 per cent. of total requirements. Lack of operating force on duty equivalent to deficient alarm service.

Means of receiving fire alarms: Alarms not received by the department. **10**

In direct pumping system use 1/10 Deficiency Scale for deficiency at pumping station, or 1/5 Deficiency Scale if pressures are raised or emergency valves operated for fire service.

6. ADEQUACY, AS REGARDS CAPACITY, OF SOURCE OF SUPPLY AND SUPPLY WORKS, TO DELIVER REQUIRED SUPPLY TO THE DISTRICT CONSIDERED.—In this item there must be con-

sidered the normal ability of the source of supply, including impounding reservoirs, and of each part of the supply works to maintain maximum consumption demands and fire flow. Filters may be assumed as capable of 25 per cent. overload capacity. In considering the source of supply, if shortage of supply is intermittent, apply deficiency under Item 7.

With supply from wells the absolutely minimum supply available under extreme dry weather conditions should not be taken as the measure of the normal ability of the source of supply. Under both items *a* and *b* the normal or average capacity of wells during the most favorable nine months period would be the average to use. To cover the deficiency under dry weather conditions an application should be made under Item 7. In making this application consideration must be given to the absolute minimum capacity of the wells under the most unfavorable conditions and also to the length of time the wells would be below maximum consumption demands; also whether this condition applies every year or only at infrequent intervals. It must be remembered that some water is available and that the most extreme conditions are not as bad as a total interruption of the supply, as would be the case in the breaking of a dam or shifting of a channel. It is probable that the deficiency will not exceed 50 per cent.

Under Supply Works, which includes intakes, suction lines, pumps, boilers, stacks, air compressors, filters (if not by-passed) and force or supply mains, storage shall be assumed as offsetting only deficiency in ability to deliver fire flow, and not deficiency in ability to meet consumption demands, except that where storage is large and records indicate no shortage in domestic consumption, it shall be assumed that no deficiency exists, if 10 hours fire flow could be obtained throughout this period for cities over 2,500 population, and 5 hours fire flow for cities under this population.

In considering the deficiency under this item, results obtained at fire flow tests in the most favorable location in the district shall be used as a basis in making calculations as to the probable deficiency under maximum consumption

conditions, due allowance being made for any emergency supply. (See page 12.) The extent of deficiency of each part of the supply works must be considered and the percentage of deficiency of the most serious used.

The ability to deliver fire supply on small fires direct without the use of fire engines increases the speed of operation of the fire department, even when full engine capacity is available; the pressure at which 10 per cent. of the required fire flow can be delivered is assumed as a measure of the value of this service and application made in all cases under Item 6*c*.

Points

a. For average domestic consumption and fire flow: Use 2 times Deficiency Scale.

b. And add for maximum domestic consumption and fire flow: ½ Deficiency Scale.

c. For each 10 pounds pressure below required pressure for direct hydrant streams at which 10 per cent. of required fire flow, but not less than 200 gallons, is available at the weakest place in the district considered. **10**

7. RELIABILITY OF SOURCE OF SUPPLY.—The effect on adequacy must be considered for such items as frequency and duration of droughts, physical condition of intakes, danger from earthquakes, floods, forest fires, ice dams and other ice formations, silting-up or shifting of channels, absence of watchmen where needed, or injury by physical means. Frequent cleaning of reservoirs, on which fire supply is largely dependent, may be considered as affecting this item. No item to be considered which is covered by requirements hereinafter given.

Use 2 times Deficiency Scale in proportion to degree of unreliability, as given on page 3.

8. RELIABILITY OF PUMPING CAPACITY on which supply is dependent, shall be on the following basis:

Pumping capacity must be such, with the two largest pumps out of service, as to maintain maximum consumption and fire flow at required pressure. For cities requiring

less than 5,000 gallons fire flow, the relative infrequency of fires is assumed as offsetting in part the probability of a serious fire occurring at times when pumps are out of service and allowance will be made accordingly.

Where storage is provided, its ability to maintain supply shall be considered, with one pump and two pumps out of service. To have no deficiency pumps and storage must be able to provide fire flow for 10 hours during a period of 5 days' maximum consumption.

Where capacity remaining, alone or in connection with storage, does not equal maximum domestic consumption, only such an amount as is available at desired pressure may be allowed; full credit will be given for pumps normally used for other service if capable of delivering against fire pressure and so connected as to be available.

In cases when adequacy and reliability of supply is also dependent upon low-lift pumps, compressors, electric generators or other separate and distinct power units, each group performing a given function must be considered separately and deficiency applied, and the points added.

If, as in a system supplied by deep well pumps, the deficiency in adequacy of supply and pumps is equal, assume it as due to supply, and do not use required quantity as basis in this item.

a. Use full Deficiency Scale for deficiency on basis of one unit out of service.

b. Add ¼ Deficiency Scale for deficiency on basis of two units out of service.

Reduce points of deficiency for b 10 per cent. for each 1,000 gallons fire flow required below 5,000 gallons.

9. BOILER CAPACITY, with a reserve of one-fourth the entire capacity, and in any case at least one boiler, must be sufficient to operate all machinery and the pumps required, as determined under Item 8, to maintain maximum consumption and fire flow, with allowance made for storage. Deficiency must be applied to all stations on which supply is dependent, including electrical generating plant.

Normally, there must be sufficient boiler capacity kept under at least ½ required steam pressure, to deliver full requirements, in connection with storage, for a period of 2 hours.

With sufficient stack or forced draft capacity, an overload of 50 per cent. over the maker's rating may be used for fire tube boilers and 100 per cent. for water tube.

a. Use ½ Deficiency Scale for deficiency in boiler capacity.

b. Add ¼ Deficiency Scale for deficiency in boilers under steam.

Reduce points of deficiency for b 10 per cent. for each 1,000 gallons fire flow required below 5,000 gallons.

10. CONDITION, ARRANGEMENT AND RELIABILITY OF PLANT EQUIPMENT.—The following forms and combinations of plant equipment, if of modern design and well constructed and installed, are assumed as approximately equal, advantages of each, if any, being in the order of their naming:

a. Centrifugal or reciprocating pumps driven by steam engines.

b. Centrifugal or reciprocating pumps driven by electric motor. Generating station must meet conditions of Items 7 to 15, inclusive, Item 8 to be generators instead of pumps, and deficiency applied.

c. Pumps operated by water power; must meet conditions of Item 7 and deficiency applied.

d. Centrifugal or reciprocating pumps operated by internal combustion engines suitable for this service. Duplicate ignition parts to be on hand for each engine. Adequate provision to be made for starting engines cold at least 6 times in rapid succession.

All equipment must be of a design applicable to the service; service record in the plant under consideration and in similar plants shall be considered and actual operating

conditions observed. Plant must be well arranged with the view to efficient operation and ease of repairs. Too limited capacity of filter plant, including insufficient sedimentation for turbid waters, and poor arrangement around filters. or other deficiencies which will reduce clear water storages below that credited under Item 6 shall be applied under this item, unless considered under Items 16 or 17. Pumps to be free from knock, with low slip, and capable of operating at full speed. Boilers to be well set, in good condition and with proper semi-annual inspection service; stacks shall be substantially installed. Electrical equipment for power to be in accordance with National Electrical Code and not liable to injury by water spray. Water power equipment must be accessible and properly safeguarded. Operating force to be competent and adequate in number to maintain fire service. Deficiency to be applied for each station on which service depends, including electric generating station.

On basis of capacity affected and degree of unreliability. A deficiency may apply under this Item even though there is no deficiency under Items 8, 9 and 11.

Use full Deficiency Scale.

11. FUEL, AND ACCESSORIES FOR THE TRANSMISSION OF POWER.—A minimum of 5 days' coal supply shall be provided; where long hauls, condition of roads, climatic conditions or other causes make a longer interruption of delivery possible, a greater storage shall be provided. Gas supply shall be from two independent sources, or from duplicate gas producer plant with a storage of at least 24 hours' gas supply. Oil supply shall be from underground storage of at least 5 days' capacity, with force feed to engine or boiler. Unreliability of gas or oil supply to boilers may be lessened by proper provisions for the use of coal. Water for power shall equal at all times that necessary to meet maximum requirements (or other power provided to equalize deficiency) and shall have proper flood and ice control.

Steam piping (or gas or oil piping with internal com-

bustion engines or to boilers) or electric transmission lines, or boiler feed, shall be so arranged that a failure in any line, or the renewal of a valve, transformer, oil pump, boiler feed pump or injector would not prevent maintaining, in connection with storage, fire flow for 10 hours during a period of 2 days' maximum domestic consumption. Overhead electric lines introduce a degree of unreliability which may be in part offset by storage; consideration in connection with such lines shall be given to number and duration of wind, sleet and snow storms, character of poles and wires, character of country traversed, effect of forest fires and ease of and facilities for repairs; the use of the same transmission line from the transformer or switch board by other plants introduces a hazard of short circuit or prior use of power and may be considered as the equivalent to the use of overhead lines in applying the schedule.

a. **Adequacy and Reliability of Fuel:**

Use ¼ Deficiency Scale.

b. **Number and capacity of Electric lines, including transformers, ~~and of boiler feed, steam, gas or oil pipes or valves, including boiler feed and oil pumps.~~**

Use ¼ Deficiency Scale.

C For overhead electric lines, add in proportion to unreliable service and installation, Full Deficiency Scale, and increase points of deficiency 1 per cent. for each mile length of overhead line on which normal service depends.

Item a may apply in addition to b.

Under Item b, if reliability of supply is dependent on two or more of the power transmission features, each shall be considered separately and a deficiency applied, except where they perform a similar function, and one offsets the unreliability of the other.

Reduce total points of deficiency for a and b 10 per cent. for each 1,000 gallons fire flow required below 5,000 gallons.

PUMPING STATION:

12, 13, 14 and 15. Pumping stations and other portions of the plant shall contain no combustible material in their construction; otherwise an automatic sprinkler equipment shall be provided; outside hydrants and hose, inside standpipes and small hose, and chemical extinguishers shall be provided. Public fire station, if within ¾ mile, shall be considered as giving about ½ protection. If pumping station is not fireproof, the several sections, particularly any with high-potential generating equipment, shall be separated by parapeted fire walls and openings protected by at least a single standard fire door or wire glass in metal frames. Station shall be protected against exposures. Electric wiring shall be in accordance with the National Electrical Code and all internal hazards safeguarded.

Points

Note.—Under Items 12 to 15, inclusive: Where 2 or more Stations are not dependent upon each other for operation, apply deficiency to the station of predominating importance. Reduce points of deficiency by the proportion that the capacity of the other stations is to the total required, then add a deficiency charge for these other stations in the proportion that the amount of their capacity necessary to maintain total required flow, in conjunction with that available from the station of predominating importance, is to the total required. Where stations are dependent on each other for operation, apply deficiency to each.

Under each of Items 12 to 15, inclusive: For each day's maximum consumption storage, deduct 1/10 the points of deficiency.

12. Construction:

a. Small amount of combustible material in roof structure. 10

Or,

b. Small amount of combustible material in roof and floors. 15

Or,

c. Considerable amount of combustible material in roof structure, floors and wainscoting and/or partitions. 25

	Points
Or,	
d. Largely or wholly frame: for each 25 per cent.	10
Note.—If sprinklered throughout, do not consider a, b or c, and charge only ½ of d.	
e. Combustible roof covering.	30
f. Sections not properly cut off.	10
Note.—The deficiency may include e and f in addition to any other one item.	
13. Insufficient fire protection, other than sprinklers:	
a. If 12 a or b applies.	5
b. If 12 c, d or e applies.	10
14. Hazards:	
a. Defective light wiring or other lighting equipment.	5
Or,	
b. Hazardous light wiring or other lighting equipment.	10
c. Power wiring defective.	10
Or,	
d. Power wiring hazardous.	25
e. Heating by stove or gas.	5
f. General care, including storage of oils, poor.	5
Or,	
g. General care, including storage of oils, very poor.	10
h. High-potential generating or transforming apparatus; if in non-fireproof building and not cut off by parapeted fire wall.	20
15. No protection:	
a. To moderate exposures.	10
b. To serious exposures.	25
Note.—If 12 d or e apply, use double the points for 15 a and b.	

16. RELIABILITY OF SUPPLY MAINS AS AFFECTING ADEQUACY.—Under this heading will be included any and all pipe lines or conduits on which supply to the distribution system is dependent; suction or gravity lines to pumping station, flow lines from reservoirs, force mains, etc., are included and a system may have one or all of these as part of it. Under 6, the adequacy of these lines under normal conditions has been considered. Consideration must be as

to greatest effect on maximum consumption and fire flow at required pressure that a break could have. If remaining mains and storage cannot deliver even maximum consumption, allow for only that amount available at required pressure. In applying, all mains which deliver from a source of supply or of storage to the principal mercantile district must be considered. Aqueducts, of good design and of substantial construction, such as masonry or concreted steel, if so installed as not to be deficient under Item 17 following, shall be considered sufficiently dependable as not to require duplication, and no application will be made as to the effect of a possible break.

The effect of a break in suction or discharge headers, lack of by-passing or poorly gated by-pass or arrangements at any reservoir, filter, etc., poorly arranged cross-connections, etc., must be considered; also features which would tend to cause or prevent an interruption of service, such as length of line, and two or more lines from the same or different sources or from storage.

Under the assumption of the most serious break, the deficiency may be considered as offset if the remaining mains, from the source of supply and storage, can provide fire flow for 10 hours during a period of 5 days maximum consumption.

Deficiency for each individual possible break must be considered, and charge made for the case giving the maximum total number of points, including the increase due to distance.

For cities requiring less than 5,000 gallons fire flow, the relative infrequency of fires is assumed as offsetting in part the probability of a serious fire occurring at times when a main is out of service and allowance will be made accordingly.

For maximum effect on maximum domestic consumption and fire flow of any single break in any main, apply ½ Deficiency Scale, and increase the points of deficiency by 1 per cent. for each 1,000 feet of

main in which a single break would produce this maximum effect.

Reduce points of deficiency 10 per cent. for each 1,000 gallons fire flow required below 5,000 gallons.

For supply lines not under vacuum and entirely on private right of way, decrease the above total by 10 per cent. for each 10 pounds pressure less than 50 pounds, for the maximum pressure carried on the lines.

17. RELIABILITY OF INSTALLATION OF SUPPLY MAINS. —Must be in good condition and reliable; cast-iron, wrought-iron, wood-stave and masonry conduit have been found satisfactory in various places and under certain conditions; service records and general conditions must be considered.

Mains shall be so laid as not to endanger each other, and their failure at stream crossings, railroad crossings and other points where physical conditions are unsatisfactory shall be guarded against; they shall be cross-connected and gated about once a mile and be equipped with air-valves at the high points and blow-offs at the low points.

The general arrangement of valves, specials and connections at cross-overs, intersections, reservoirs and discharge and suction headers must be considered, with the view to quickness in shutting down breaks; the need of check valves on supply or force mains and other arrangements to prevent flooding stations or emptying reservoirs at time of a break in a main must be considered, also of relief valves or surge chambers on long lines. Ease of repairs shall be considered; the repair of a valve resulting in the total interruption of supply would apply as moderately unreliable.

If more than one main and conditions do not affect all, apply in proportion to the carrying capacity affected, and the degree of unreliability. A deficiency may apply under this item even though there is no deficiency under Item 16.

Use ½ Deficiency Scale in proportion to degree of unreliability.

Points

18. ARTERIAL SYSTEM.—In connection with the supply mains, arteries and secondary feeders shall extend throughout the system. These feeders shall be of sufficient size, considering their length and the character of the sections served, to deliver fire flow necessary for the district, shall be frequently spaced (about every 3,000 feet) and looped; practical dependence of large sections on single mains constitutes a deficiency. Basis of deficiency applied to be the results of fire flow tests and general consideration of the arrangement.

a. Fair.	10
b. Poor.	20
c. Very poor.	50

19. INSTALLATION.—Mains of the arterial system shall not be laid across filled ground, and shall have special construction at railroad crossings and near bridge abutments, and shall be so gated that not more than ¼ mile within the distribution system will be affected by a break. All mains shall have sufficient cover to prevent freezing, with a minimum cover of 2 feet to prevent injury from traffic.

a. Slightly unreliable.	5
b. Moderately unreliable.	10
c. Seriously unreliable.	25

Note.—Consideration not to be given to conditions already covered by 17 above.

20, 21, 22 and 23. MINOR DISTRIBUTERS AND GRIDIRON SYSTEM.—Six-inch to be considered the minimum size satisfactory for hydrant supply in residential districts; to be closely gridironed with 6-inch cross-connecting mains at intervals not exceeding 600 feet, or where initial pressures are high a satisfactory gridiron may be obtained by a liberal per cent. of larger mains cross-connecting the 6-inch at greater intervals; in new construction, 8-inch should be used where dead ends and poor gridironing are likely to exist for some time, and 6-inch only where blocks are 600 feet or less in length. In high value districts, the

minimum size to be 8-inch with cross-connecting mains at distances as given above; 12-inch and larger mains to be on the principal streets and for all long lines not cross-connected at frequent intervals.

20. Effect of Small Mains in High Value District Considered:

For deficiency in fire flow in the part of the district where the least supply is available, whether due to weakness in the system or low pressures.

Use full Deficiency Scale.

Per cent. of deficiency to be based on fire flow obtained at strongest point in district, except where this exceeds required fire flow, in which case the latter should be used as basis. In all cases comparison shall be on the basis of the flow available for engine supply.

21. Small Mains in the Distribution System:

a. For per cent. of 4-inch or smaller mains supplying hydrants:

Use ½ Deficiency Scale.

b. Add 1 point for each mile of 4-inch or smaller pipe.

Do not include areas in which block fronts have less than ⅕ the lots built upon, or which are separated from the main system by a natural barrier or considerable open space, nor in larger cities areas outside a 5-mile radius of the district considered. Do not exceed a total of 200 points.

Reduce the points of deficiency (sum of a and b) 5 per cent. for each 10 pounds average normal static pressure above 20 pounds if the fire department response throughout the city is such that at least 500 gallons actual engine capacity is available from one or two companies, otherwise for each 10 pounds pressure above 60 pounds. Normal static pressure to be assumed as that carried normally at time of fire. Where there are marked differences in pressure due to topography or separate services, both the above may apply, and the average reduction made.

Points

22. Dead Ends: 6-inch and smaller pipe dead ended and supplying hydrants, including dead ends at service limits, on basis of total length of pipe.

a. For per cent. of dead ends:

Use ½ Deficiency Scale.

b. Add 1 point for each mile of dead ended pipe.

Do not include areas in which block fronts have less than ⅕ the lots built upon, or which are separated from the main system by a natural barrier or considerable open space, nor in larger cities areas outside a 5-mile radius of the district considered.

Reduce the points of deficiency (sum of a and b) 5 per cent. for each 10 pounds average normal static pressure above 20 pounds if the fire department response throughout the city is such that at least 500 gallons actual engine capacity is available from one or two companies, otherwise for each 10 pounds pressure above 60 pounds. Normal static pressure to be assumed as that carried normally at time of fire. Where there are marked differences in pressure due to topography or separate services, both the above may apply, and the average reduction made.

23. Gridiron (average condition in closely built residential sections): 6-inch or smaller mains on long side of block, with 8-inch or larger cross-connections:

a.	At	intervals	of	600	to	900 feet.	15
b.	"	"	"	901	"	1,200 "	30
c.	"	"	"	1,201	"	1,500 "	45
d.	"	"	"	1,501	"	1,800 "	65
e.	"	"	"	1,801	"	2,100 "	85
f.	"	"	"	2,101	"	2,400 "	100
g.	"	"	"	2,401	"	3,000 "	115

If cross-connections are 6-inch or smaller, increase points of deficiency by 50 per cent.

Do not apply where deficiency under Item 22 exceeds 75 per cent.

Reduce the points of deficiency 10 points for each 10 pounds average normal static pressure above 20 pounds if the fire department response throughout the city is such that at least 500 gallons actual

Points

engine capacity is available from one or two companies, otherwise for each 10 pounds pressure above 60 pounds. Normal static pressure to be assumed as that carried normally at time of fire. Where there are marked differences in pressure due to topography or separate services, both the above may apply, and the average reduction made.

24. PIPE.—In distribution system, pipe to be of satisfactory quality and properly tested for soundness and tightness of joints. The use of cast-iron pipe under pressure double that specified for the class is considered as introducing an unreliable feature, particularly where pressures are raised for fires; tests before backfilling and favorable service records of several years duration may be assumed as offsetting this defect in part.

For cement-lined pipe, or wood or metal pipe in unreliable condition. 50

Increase points of deficiency 2 points for each mile of such pipe.

25. ELECTROLYSIS conditions to be studied and methods of prevention applied.

For conditions favorable to electrolytic action. 10

Note.—If there is evidence of recent serious electrolytic action, double the above points.

26. GATE VALVES.—The distribution system shall be equipped with a sufficient number, so located that no single case of accident, breakage or repair to the pipe system, exclusive of arteries, will necessitate the shutting from service a length of pipe greater than 500 feet in high value districts, or greater than 800 feet in other sections, and will not result in shutting down an artery.

Spacing in high value districts:

a. Average 600 to 900 feet. 10

b. Average over 900 feet. 25

Spacing in residential districts:

c. Average 900 to 1,500 feet. 5

d. Average over 1,500 feet. 15

27. INSPECTION AND CONDITION OF VALVES.—All valves to be inspected yearly and large valves more frequently, and be kept in good condition; the presence of some valves operating in opposite direction is to be considered the equivalent of unsatisfactory condition, ranging from fair to poor, depending on the number and importance.

Gate valves not inspected regularly or in poor condition:

Use 1/10 Deficiency Scale.

28 and 29. HYDRANT DISTRIBUTION.—Shall be sufficient to give an average area served, in proportion to the fire flow, as follows; where no engines are in service direct hydrant stream spacing to be required, regardless of the pressure. Where direct streams are used, 4- or 6-way hydrants with independent gates on outlets may be assumed as two hydrants in figuring area served. Where it is the practice of the fire department to connect two engines to a hydrant, those with two steamer outlets may be assumed as 1½ hydrants. Cisterns with supply connections may be counted as hydrants.

Fire Flow Required, Gallons per Minute.	Average Area per Hydrant, Square Feet.
Engine Streams	
1,000	120,000
2,000	110,000
3,000	100,000
4,000	90,000
5,000	85,000
6,000	80,000
7,000	70,000
8,000	60,000
9,000	55,000
10,000	48,000
11,000	43,000
12,000	40,000
Direct Hydrant Streams	
1,000	100,000
1,500	90,000
2,000	85,000
2,500	78,000
3,000	70,000
4,000	55,000
5,000 and over	40,000

	Points
28. Area served in high value districts in excess of requirements:	
For each 10,000 square feet.	**10**
The actual area of the high value district to be used in estimating the area served per hydrant, and boundary hydrants to be considered as ½ a hydrant.	
29. Area served in the residential district in excess of requirements:	
For each 10,000 square feet.	**3**
Residential district to include all that area contiguous to the district considered in which block fronts have ⅕ the lots built upon, but to exclude the high value district. The charge to be applied on the above basis even though there are no hydrants in the residential district, but in no case to exceed 400 points.	
If on first alarm in residential district, an average of ½ the companies have engines, use engine basis.	

30. CONDITION OF HYDRANTS.—Hydrants shall be inspected in the spring and fall of each year, after use at fires during freezing weather and daily in high value districts during protracted periods of severe cold.

a. Not inspected, or in only fair condition.	**10**
b. In poor condition.	**20**

31 and 32. SIZE AND INSTALLATION OF HYDRANTS.—Hydrants shall be able to deliver 600 gallons per minute, with a loss of not more than 2½ pounds in the hydrant and a total loss of not more than 5 pounds between the street main and outlet; they shall not have less than two 2½-inch outlets and also a large suction connection where engine service is necessary. They shall be of such design that when the hydrant barrel is broken off the hydrant will remain closed. Street connection shall be not less than 6 inches in diameter and shall be gated. Hose threads on outlets should conform to the National Standard. Flush hydrants, requir-

Points

ing chucks to be screwed on, are considered undesirable, especially in sections of the country subject to heavy snow storms, because of delay in getting in operation. Cisterns are considered as of improper type.

31. **Hydrants too small or of improper type; to include all with 4-inch connection to main, or with small barrel or foot valve, except those hydrants with large suction outlet in cities using engines and with static pressure of at least 60 pounds; also to include all with single 2½-inch outlet, and all flush hydrants requiring chuck to be screwed on or where covers over hydrant barrel or operating nut of controlling gate are liable to be frozen in or covered by heavy snow fall, except that flush hydrants, with an adequate number of chucks provided having more than one 2½-inch outlet, are to be considered on basis of ½ deficient. If in the high value district considered, there are more hydrants than are required for proper spacing, and the small hydrants are not generally used by the fire department, use in determining the deficiency only the number of small hydrants required to make up the total number necessary for proper distribution; i. e., do not charge for the surplus small hydrants.**

    a. **Use ⅕ Deficiency Scale for those in high value districts.**

    b. **And add ⅕ Deficiency Scale for those elsewhere.**

Reduce points of deficiency for b 5 per cent. for each 10 per cent. of 4-inch and smaller pipe charged for under Item 21.

32. **Hydrant connections to street main not gated;**

Each 10 per cent. 1

If 26 b or d apply, use double the points.

If no deficiency under 26, do not apply 32, unless hydrants on main arteries are not gated, in which case use a total of 10 points.

FIRE DEPARTMENT.

Note.—For cities with no organized fire department, no credit will be given for apparatus and a full deficiency of 1,500 points applied.

For cities of under 10,000 population having any organized fire department—volunteer, call, part paid or fully paid—application shall be made on all Items, and because of infrequency of fires, a deduction made as follows:

From the sum of points of deficiencies applying to Items 1, 2, 3, 4, 5, 6, 7, 14, 15, 19, 21, 25, 27, 33 and 34; deduct 10 per cent. for each 1,000 population below 10,000 population.

There shall be a chief, and for over 2 companies, an assistant or deputy chief, who shall be in charge in the absence of the chief. For over 12 companies there shall be also a chief officer (Battalion or District Chief) on duty at all times, for each additional 8 companies; such officers shall not be credited in the company strength. There shall be sufficient company officers to have one on duty at all times with each engine, hose or ladder company, or each combined company. Call officers, *i. e.,* officers who receive some pay for services, but do not devote their entire time to fire department duty, and volunteer officers shall be considered as equivalent to ½ full paid officers.

a. Use ⅕ Deficiency Scale for chief officers.
b. Add ⅕ Deficiency Scale for company officers.

2. Operators.—There shall be a sufficient number of competent operators (engineers, stokers and chauffeurs) so that one shall be on duty at all times for each engine or motor-driven apparatus.

Use ¼ Deficiency Scale.

3. Qualifications of Chief Officers.—Chief officers shall be experienced in fire service.

Not qualified:
a. Use 1/10 Deficiency Scale for chief.
b. Add 1/20 Deficiency Scale for other chief officers.

Points

4. CHIEF'S TENURE OF OFFICE.—Chief shall hold office for an indefinite term and be removable only for cause after public trial.

Chief removable without cause. 10

5. APPOINTMENT AND PROMOTION OF OFFICERS.—Officers' appointment and promotion shall be based on examination, seniority and record, under civil service rules with tenure of office provisions.

Method of appointment and promotion of officers:
a. Fair. 5
b. Poor. 10

6. ENLISTMENT AND PROMOTION.—Privates' enlistment shall be under civil service rules and based on physical and mental examination, with satisfactory age, weight and height limits; permanency to be only after a satisfactory probation of 6 months. Special training and examinations shall be required for engineers and chauffeurs.

Method of enlistment and promotion of privates:
a. Fair. 5
b. Poor. 10
c. Very poor. 20

7. RETIREMENT.—Full paid members shall be retired at the age of 62, unless unusually efficient at that time; proper and ample means shall be provided for pensioning men for long service or disability.

Provisions or enforcement for retirement:
a. Fair. 5
b. Poor. 10
Not to apply for age limit if no member is over 55 years of age.

8. APPARATUS REQUIRED FOR ENGINE AND HOSE COMPANIES.—The amount of apparatus in service and regularly responding to alarms should be sufficient to properly protect the city and shall be on the basis of companies required, it being assumed that each engine or hose company will be pro-

vided with a hose carrying vehicle, and that in cities of over 100,000 population one-half the engine companies that should attend any first alarm in high value districts will be provided with a steam or automobile fire engine and a separate hose wagon; other engine companies may have only a combined pump and hose wagon.

Every properly equipped piece of apparatus regularly responding to alarms shall be considered as a separate company, whether so organized or not, except that to be considered as an engine company there must be an accompanying hose wagon or hose must be carried on the pumping equipment.

When one piece of equipment carries 500 feet or more of hose, a 40-foot or longer extension and at least 4 other ladders, including 2 roof ladders, grade as a hose company, if necessary to reduce deficiency under Item 8, and allow credit as ½ a company under Item 9, but allow credit as for a full ladder company under Item 10. If an adequate number of hose companies, assume as a ladder company under Item 9.

Apparatus may be hand, horse or motor drawn. Where 80 per cent. of the apparatus is motorized, the formula for automobile companies may be used.

P = Population in thousands.

For cities under 50,000:

Number of Engine and/or Hose Companies =

1.0 + 0.14 P. for horse-drawn.
0.85 + 0.12 P. for automobile.

For cities having population of 50,000 to 200,000:

Number of Engine and/or Hose Companies =

4 + 0.08 P. for horse-drawn.
3.4 + 0.07 P. for automobile.

For cities having population in excess of 200,000, the number of Engine or Hose Companies depends on distribution, as covered by Item 10, and on the

ability to handle two simultaneous large fires without leaving all other sections of the city unprotected.

Note.—In certain cities a number in excess of the above will be required, depending on the structural conditions found in the city. Where the topography and general layout of the city require, for proper distribution, a greater number of companies than determined by the formula, deficiency will be applied under Item 10.

In cities almost solely residential in character, such as suburbs in metropolitan districts, or where the city has small local high value centers needing less protection than the formula for companies calls for, the estimate will be based on the population corresponding to the fire flow believed necessary, as used in Item 6, Water Supply, except that where such cities have congested shingle-roof frame districts, at least 2 additional companies must be provided to protect the city in case of a second fire.

The number of companies in service shall be assumed as increased by companies available as outside aid, where by regular assignment the response of such companies is provided for to the district considered or to fill in; such increase to be made on the basis of one outside aid company equaling ½ a company in service, but not to exceed a total increase in excess of ⅓ the total number of companies required. Where adequate provision is not made for mutual aid from outside companies, the full number of companies available within 30 minutes shall be allowed as a credit equal to ⅓ the points which this number decreases the deficiency in actual companies; if hose couplings are not interchangeable or adapters provided, this credit shall equal only ¼ the points.

Use full Deficiency Scale for Numerical Deficiency of Apparatus.

9. LADDER COMPANIES.—In cities having 5 buildings 3 stories or higher, there shall be one ladder company; in cities over 20,000 population, the number of ladder com-

panies shall equal 1 + 0.03 P.; for cities of over 200,000 population, the number of companies will depend upon distribution as covered by Item 10. Where no ladder company is required, application shall be made under *a* below for deficiency in ladder equipment on other apparatus to reach the roof of 2-story buildings; this requires a 24-foot and a roof ladder. An aerial ladder must be provided in a district where 5 buildings are 4 stories or higher and one ladder truck in 5 shall be aerial. In applying *a* and *b* below, a fully equipped truck in reserve ready for service may be considered as ½ value of a truck in service. Credit shall also be allowed for outside aid as under Item 8.

A reserve ladder truck shall be provided for each five, or fraction thereof, required; where the number of ladder trucks in service exceeds the number required or ladder trucks are in service in territory where short ladders carried on hose wagons are sufficient, these may be considered as reserve.

For per cent. of numerical deficiency:

a. Use 1/3 Deficiency Scale for ladder trucks in service.

b. Add 1/10 Deficiency Scale for deficiency in aerial trucks.

c. Add 1/10 Deficiency Scale for reserve trucks.

d. Add 1/10 Deficiency Scale for poor condition of trucks in service.

10. DISTRIBUTION OF COMPANIES.—In general, distribution shall be such as to provide an Engine or Hose Company and a Ladder Company within the following distance of every point in a district, measured by the most direct route.

District.	Horse-Drawn.		Automobile.	
	Engine or Hose Co.	Ladder Co.	Engine or Hose Co.	Ladder Co.
Mercantile or Manufacturing	½ mile	¾ mile	¾ mile	1 mile
Closely built residential	1 mile	1½ miles	1½ miles	2 miles
Scattered residential	1½ miles	1½ miles	3 miles	3 miles

The above requirements will vary, depending on the topography and character of the city. Hand-drawn apparatus is considered on same basis as horse-drawn, the lack of horses being covered by Item 26.

If the additional companies required under Items 8 and 9 are sufficient to give proper local distribution as per above table, do not apply deficiency under this Item.

Where a company is properly located to give protection to the territory included in its running district but is not provided with apparatus of proper type; for instance, is equipped only with a hose wagon when pumping equipment is needed for local protection, or has a service truck where an aerial is required, a deficiency applies under this item, unless sufficient equipment of proper type will be provided by removing deficiency now existing under Items 9*b* or 13.

Apparatus not of proper type should, however, not be considered as serious as the lack of a company. In general, the deficiency as applying to apparatus would be ⅓ to ⅔ of that due to the lack of a fire station, men and apparatus, all of which are commonly considered as comprising a company.

10. For per cent. of numerical deficiency of companies, and/or of companies or apparatus not properly located.

a. Use ½ Deficiency Scale for engine or hose companies in the district considered.

b. Add ¼ Deficiency Scale for engine or hose companies in other districts.

c. Add ¼ Deficiency Scale for ladder companies in the district considered.

d. Add 1/10 Deficiency Scale for ladder companies in other districts.

11 and 12. MAINTENANCE OF COMPANIES.—Strength of Companies shall be maintained as follows:

COMPANIES.	Least Number of Men on Duty.	
	Day Time.	Night Time.
Within or near any High Value District:		
Engine Company	7	9
Ladder Company	7	9
Hose Company	5	7
Water Tower Company	1	1
In Other Districts:		
Engine Company	5	7
Ladder Company	5	7
Hose Company	3	5

In places of less than 50,000 population, consider as high value hose or engine companies the number necessary for first alarm as required in Item 30, regardless of the location of the others. Where an aerial truck is not required (See Item 9), consider ladder companies on 5-man basis, regardless of location.

A hose or ladder company, equipped with one piece of apparatus serving both purposes, and credited under both Items 8 and 9, or as both a hose company and a ladder company under Item 10, requires a minimum strength of 3 men more than a hose company if in a residential section, or 5 men more than a hose company if in a high value district.

Note A. The above strength of engine companies is based upon the use of steam fire engines; one man less may be allowed in companies having automobile pumping engines.

Note B. If drivers do not perform fire duty, the above strength of companies affected must be increased by one.

Note C. Where high pressure fire systems are in use and a man is detailed to remain at the hydrant, strength of hose companies in the district served must be increased by one.

Note D. The minimum above may be decreased by one man, in ladder companies having quick-raising aerial trucks.

Note E. Where auxiliary squads, or chemical companies equipped with straight chemical engines, respond to alarms the manual strength of these companies may be assumed as offsetting by one the deficiency in other companies, the number of companies affected in each district considered being the same as the strength of the auxiliary squad during the time when the strength of the other companies is a minimum.

Note F. In departments having call or volunteer members, with tappers in houses and places of business or sufficient tower bells, horns or whistles, four call or eight volunteer members, on basis of average number responding to alarms, may be considered as equivalent to one full paid member, up to ⅓ the least number required to be on duty at all times. Volunteer members receiving pay for fire service

shall be considered on call basis. Call or volunteer members sleeping at fire stations may be considered as the equivalent of paid men in estimating the night strength.

Credit may be given for paid men off duty, on the same basis as call men, if provision for notification is ample and the regulations require them to respond during meal periods, and on time off.

Note G. For outside aid companies regularly assigned in the running card and assumed under Item 8 as the equivalent to companies in service, ½ the combined least number of men on duty will be assumed as the strength of the companies thus allowed. For outside aid companies for which adequate provisions for response have not been made, the actual least number of men will be used in estimating the credit to be allowed.

When, in the city being graded, the companies are manned by volunteer or call men and the membership is large, greatly exceeding the number assumed as equal to ⅓ the number of paid men required, there is no actual benefit to manpower by response of other volunteer or call companies as outside aid, therefore no credit will be allowed for this outside aid, except for such full paid men as respond with the outside aid. Credit may, however, be allowed for outside aid apparatus under Items 8 and 9.

11. For deficiency in total company membership of the department, based on the least number of men required to be on duty at all times with the existing companies and the added companies required under Items 8 and 9, and under Item 10, if by relocating companies adequate distribution cannot be obtained.

a. For minimum strength in the day time:
Use full Deficiency Scale.

b. For minimum strength at night:
Use full Deficiency Scale.

Deduct for outside aid available within 30 minutes, for which no adequate assignment of response is made, a credit equal to 1/3 the points which the combined least number of

	Points
men on duty in the companies thus available decrease the deficiency in men.	
12. Strength of existing companies (minimum usually on duty) within or near the high value district considered:	
a. Average 1 man deficient.	**10**
b. " 2 men "	**20**
c. " 3 " "	**40**
d. " 4 " "	**60**
e. " 5 " "	**80**
f. " 6 " "	**100**
g. " 7 " "	**125**

13. ENGINE CAPACITY.—There must be provided a total pumping capacity equal to ⅔ the required fire flow.

In cities of over 200,000 population, and requiring fire flow for two simultaneous fires, engine capacity must be provided equal to ⅔ the total fire flow required for the district.

In cities where the fire flow required in the high value district is less than that corresponding to the population, but there is a residential district of large extent and high conflagration hazard, the engine capacity required shall be on the basis of a fire flow of 2,000 gallons in addition to the amount necessary to protect the high value district, to provide protection for a simultaneous second fire.

Where fire streams are available in the district considered from a High Pressure Fire System (for description see page 76), its capacity shall be considered as engine capacity, except that if residual pressures are less than 250 pounds, actual engine capacity shall still be provided as given in the table on page 43.

In estimating engine capacity available, reserve engines, or engines from other cities for which a regular running card assignment is made, either to respond to the district considered or to fill in for other companies, or fire-boats, in conjunction with fire-boat lines, shall be considered at ½ their actual capacity, as offsetting delay in getting into service, but not to exceed ⅓ the total engine capacity required. Where adequate provision is not made for

mutual aid from outside companies, the full engine capacity available within 30 minutes shall be allowed as a credit equal to ⅓ the points which this capacity decreases the deficiency in actual engine capacity; if hose couplings are not interchangeable nor adapters provided, this credit shall equal only ¼ the points.

Capacity of engines to be that obtained at tests; where no test capacities are available, no engine to be considered as of more than 80 per cent. of its rated capacity, and in no case of more than 1,000 gallons capacity.

In districts having a *domestic* supply capable of delivering, at a residual pressure permitting direct hydrant streams, a fire flow in all parts of the district in excess of the engine capacity available, credit may be given for ⅔ this excess in determining the deficiency in engine capacity. Where buildings are 4 stories or higher, some engine capacity may be required, as specified in the table below, and a deficiency applied, even though full fire flow is available at pressures at which direct hydrant streams can be used.

ENGINE CAPACITY REQUIRED ON ACCOUNT OF HIGH BUILDINGS.

When Full Fire Flow, as Calculated Under Water Supply, is Obtainable at Residual Pressures of:			Number of 4-Story and Higher Buildings in District Considered:
90 Pounds.	75 Pounds.	60 Pounds.	
Required Engine Capacity in Per Cent. of Fire Flow.			
0	0	10	1– 5
0	0	20	6– 10
0	10		11– 20
0	15		21– 30
10	20		31– 50
15	30		51– 75
25	50		76–100
33	67		101 or more.

No engine capacity required where full fire flow is available at 150 pounds and no building exceeds 10 stories in height; for pressures intermediate between 90 and 150 pounds, proportional engine capacity is required.

a. For total engine capacity:

i. e. for full tested capacity of engines in service; ½ tested capacity of reserve engines; ½ tested capacity of outside aid engines regularly responding; 2/3 fire flow available at hydrant stream pressures at weakest point in the district considered, after deducting the above engine capacity; and supply from high pressure fire systems, and ½ supply from fire boat lines.

Use 1½ times Deficiency Scale.

Deduct for outside aid available within 30 minutes, for which no adequate assignment of response is made, a credit equal to 1/3 the points which the full capacity of this aid decreases the deficiency in total capacity.

b. Where no deficiency is applied under "a" because full fire flow is available at pressures permitting direct hydrant streams, apply:

For deficiency in engine capacity necessary on account of high buildings, as given in the table on page 43:

Use ¼ Deficiency Scale.

14. RESERVE ENGINES.—The total engine capacity, including reserve engines, with ⅛ of the regular engines, including the largest, out of service, shall be sufficient to maintain the total required engine capacity, under Item 13*a* or *b*. The ability of the water supply to deliver a portion of the fire flow at pressures permitting direct hydrant streams may offset the need of reserve engine capacity.

To maintain engine companies, at least one engine shall be in reserve for every 8 engines or major fraction thereof required to be in service, but not less than one.

Where automobile hose wagons are provided, reserve steamers shall have suitable provision for towing.

a. For Reserve Engine Capacity:

Use 1/10 Deficiency Scale.

b. For Number of Reserve Engines:

Add 1/10 Deficiency Scale.

Deduct 10 per cent. of the total points of deficiency for a and b for each 10 pounds above 30 pounds at which 10 per cent. of the required fire flow, but not less than 500 gallons, is available at the weakest place in the district considered.

Points

15. CONDITION OF ENGINES AND HOSE WAGONS.—Engines shall be kept in good condition; the absence of annual tests and tests after all repairs, in accordance with National Board of Fire Underwriters' rules for testing, may be considered a deficiency. Suction coupling threads shall be uniform on engines and hydrants. Hose wagons shall be in good condition, of sufficient strength for the service and weight to be carried.

a. Engines. Use ⅕ Deficiency Scale.

b. Add, for each different thread on engine suctions, more than one. **5**

c. Hose Wagons. Use ⅕ Deficiency Scale.

16. FIREBOATS.—A fireboat shall be required where there is an occupied wharf frontage of one mile and additional boats such as to give a proportion of one to each three miles of wharf frontage. Total fireboat capacity to be equal to ½ the required fire flow for the district protected.

For privately owned fireboats or tugboats with fire pumps and turrets, if operating only in the harbor and if arrangements are made for their regular response to waterfront alarms and for their operation under the chief of the fire department, credit shall be allowed equal to ½ the points which such boats decrease the points of deficiency in municipally owned fireboats. If such boats are not regularly tested, this credit shall equal only ⅓ the points.

a. For number of boats:
Use ½ Deficiency Scale.

b. And add, for capacity:
¼ Deficiency Scale.

This item to be considered only when applying the Grading Schedule to a waterfront district.

17. POWERFUL STREAM APPLIANCES.—Suitable appliances shall be provided for handling powerful streams, except where less than 1,000 gallons of water are available as direct hydrant streams or from fire engines, or where not more than 5 buildings in the high value district

Points

considered are 3 stories or higher; these shall include turret or monitor nozzles, siamese connections, deluge sets and cellar pipes, properly distributed and in proportion of one to each four companies. A water tower or ladder pipe must be provided where 5 buildings are 4 stories or higher; water towers are required in high value districts having over 10 buildings 6 stories and higher, such that one shall be within 1½ miles of every building 6 stories high.

a. For each water tower deficient, if needed. 10

b. For other appliances: Add ½ Deficiency Scale.

18. CHEMICAL EQUIPMENT.—Each piece of apparatus carrying hose or ladders shall have two 2½-gallon or larger portable extinguishers, and sufficient apparatus (chemical engines or combination hose wagons or ladder trucks) shall carry 35-gallon or larger chemical tanks to enable two pieces so equipped to respond to each first alarm. Water tanks operated in conjunction with booster pumps or compressed air or gas are considered the equivalent to chemical tanks. Consider companies carrying 150 feet of small hose for use on 2½-inch water lines as of ½ value of chemically equipped apparatus. Where static hydrant pressures are less than 60 pounds, allow only ½ credit for chemical tanks on pumping engines.

Use ½ Deficiency Scale for numerical deficiency of large tanks.

For the average excess per company carried in a second tank on any apparatus or in additional portable extinguishers over the 2 required, reduce points of deficiency 1 per cent. for each gallon.

19. RESERVE HOSE WAGONS.—There shall be maintained in reserve at least one hose wagon for each 12 or fraction thereof required (8 or fraction thereof if automobiles). Exercise or supply wagons, if suitable for the use, may be considered as reserve hose wagons. One or more reserve hose wagons must be loaded with at least 1,000 feet of hose, preferably 3-inch. Where more hose wagons are in service than called for under Item 8, a reserve loaded hose wagon is not required.

For deficiency in number of reserve hose wagons, based on 1/12 (or ⅝) the companies required: Use ⅕ Deficiency Scale.

Add, for lack of loaded reserve hose wagon, 5 points if 3-inch hose is not supplied and 10 points if no hose.

20. HOSE.—Each engine or hose company shall carry at least 1,000 feet of 2½-inch or larger hose and shall be provided with a complete spare shift; hose on reserve hose wagon may be considered as spare hose where two or less hose companies are required. For cities of less than 50,000 population, if more companies are provided than called for under Item 8, the total amount of hose carried by all apparatus, divided by the required number of companies shall be considered as the average amount carried per company.

a. For average amount of hose carried per company: Use ½ Deficiency Scale.

b. Add for average spare hose per company: ¼ Deficiency Scale.

21. HOSE; LARGER THAN 2½-INCH.—For hose companies responding to first and second alarms in mercantile or manufacturing districts where direct hydrant streams are used, at least half the hose carried on wagons shall be 2¾-inch or 3-inch; for engine companies, and hose companies in all other districts, at least 200 feet of large hose shall be carried on each wagon. Large hose not to be required where less than 1,000 gallons of water are available as direct hydrant streams or from engines, or where not more than 5 buildings in the high value district considered are 3 stories or higher.

a. For deficient large hose in Engine Companies: Use 1/10 Deficiency Scale.

b. For deficient large hose in Hose Companies: Use ⅕ Deficiency Scale.

Points

Apply a and b in the proportion that the number of engine and hose companies are to the total in service.

22. CONDITION OF HOSE.—Hose shall be in good condition; a service of 7 years should be expected before being in such condition as to require discarding; hose over 5 years old shall not be used in important companies, and if not regularly tested such hose shall be considered as in poor condition. Hose couplings and 2½-inch hydrant outlet threads shall be uniform.

a. For per cent. of total amount of hose in service in poor condition, or over 5 years in service if not tested:

Use ¼ Deficiency Scale.

b. Add, for each different thread more than one. 5

23. MINOR EQUIPMENT.—Complete minor equipment shall be provided for each company; this to include shut-off nozzles from ¾-inch to 1¼-inch and open smooth-bore nozzles from 1⅛-inch to 1½-inch, short ladders, portable extinguishers, salvage appliances, including waterproof covers, and sufficient small equipment to enable the firemen to perform their work with greatest facility and despatch.

Use ⅕ Deficiency Scale.

24. FUEL.—Good quality quick steaming coal, and gasoline where automobiles are used, shall be provided in sufficient quantities at convenient points and ready for quick handling.

a. Poor engine fuel. 5

b. Inadequate methods of handling. 5

25. REPAIR FACILITIES.—Adequate, preferably departmental, facilities for making ordinary repairs in any municipality and major repairs in cities over 50,000 population must be provided. It is particularly desirable to have equipment standardized; wheels, poles, all hose couplings, play-

Points

pipes, tips, and minor equipment. Spare parts, fittings, tools, poles, wheels and tires should be on hand.

Repair facilities and spare parts:
Use ⅕ Deficiency Scale.

26. HORSES OR MOTIVE POWER.—Suitable horses shall be provided for all apparatus (except automobiles) in service, but not to exceed the apparatus necessary for the required number of companies as determined under Items 8, 9 and 10; reserve horses shall be provided, equal to 5 per cent. of the number in service, but not less than 2 horses where over 6 pieces of apparatus are in service, nor less than 1 horse where over 3 pieces of apparatus are in service. If hired horses are used or if horses are used for other than fire department purposes (street sprinkling, etc.), grade horses affected as 50 per cent. deficient. Automobile apparatus shall have motors of sufficient horsepower for the road conditions and grades.

a. For numerical deficiency of horses:
Use ½ Deficiency Scale.

b. For per cent. of automobiles with insufficient motor power:
Use ¼ Deficiency Scale.

Apply a and b in proportion that the number of hand or horse drawn companies and automobile equipped companies is to the total number in service.

27. FIRE STATIONS.—Houses shall be adapted for the service, as applying to ease and quickness of response; each engine or hose company station shall have hose-drying facilities. Engine heaters shall be provided where engines are depended upon for first streams.

a. Houses unadapted for the service:
Use ⅕ Deficiency Scale.

b. Engines not on heaters. 10

28. REGULATIONS AND DISCIPLINE.—Provision shall be made in complete printed regulations for control of the department and authority given the chief to enforce them, subject to review or confirmation by the supervising body or the civil service commission. Discipline shall be rigidly

maintained and fines and suspensions impartially imposed and sustained.

Provision for and enforcement of discipline:
Use ½ Deficiency Scale.

29. DRILLS AND TRAINING.—Drills in charge of a competent officer shall be regularly held at a drill tower for all company members of the department. Drills shall be classed as not better than 30 per cent. deficient if only for newly enlisted men, or if no drill tower is provided.

Use ⅕ Deficiency Scale.

30. RESPONSE TO ALARMS.—An adequate running card shall be established, providing for first and subsequent alarms, and for outlying companies to occupy vacated stations. Apparatus shall respond to all first (including telephone) alarms in amount commensurate with the normal hazard of the district, but not less than as follows:

In mercantile and manufacturing districts:

Not less than 2 engine or hose companies and 1 ladder company in cities under 25,000 and over 4,000 population.

Not less than 3 engine or hose companies and 1 ladder company in cities over 25,000 and under 50,000.

Not less than 4 engine or hose companies and 2 ladder companies in cities over 50,000.

In residential districts: One engine or hose company for cities under 4,000 population. For over this population, not less than 2 engine or hose companies and adequate ladder equipment. In densely built sections and where buildings approach the dimensions of hotels, the response should be greater and in some cases equal that for mercantile or manufacturing sections.

For response to first alarms:

a. Use ¼ Deficiency Scale for high value districts.
b. Add ¼ Deficiency Scale for residential.

Note.—Deficiency to be figured separately for box alarms and telephone alarms, and the points of

Points

deficiency applied in ratio of the number of each kind to total first alarms.

When the number of companies in service is in excess of the required first alarm response and the running card does not provide for response to second and subsequent alarms, nor for moving in of companies, add:

c. No provision for subsequent alarms. 10

d. No provision for moving in. 10

31. FIRE METHODS.—These shall be modern and include the liberal use of chemicals, shut-off nozzles and salvage appliances to reduce water damage, the use of appliances for powerful streams on serious fires, suitable ladder work and ventilation and the general policy of attaching lines to siamese connections serving sprinklers and standpipes. Lack of proper equipment to be considered in determining deficiency in fire methods.

For ineffective fire methods:
Use Full Deficiency Scale.

32. CONDITIONS AFFECTING FIRE DEPARTMENT OPERATIONS.—All streets in closely-built sections of the city, approximately the district covered by the water distribution system, to be paved and in good condition. Macadam or similar pavements are satisfactory in residential districts.

a. For streets not paved and/or in poor condition:
Use ¼ Deficiency Scale.

Railroad grade crossings, drawbridges, automobile parking and other similar features shall be considered in respect to the probable delay in response; also pavements, cross-walks, gutters and steep grades which prevent rapid movement of apparatus. Traffic regulations and ordinances giving fire department right of way shall also be considered.

b. Conditions causing delays in response to the high value district considered:

Few. 10

Many. 20

Points

The presence in the high value district of considerable overhead wires in streets, alleys and rear of buildings, and of trolley wires in streets less than 80 feet wide, introduces a more or less serious obstruction to the use of ladders and tends to break up fire streams or to hinder the use of water towers, ladder pipes, etc.; where such wires, or some of them, carry high-potential current, the danger to firemen from coming in contact with charged wires is often severe, especially if no arrangement is made to quickly cut out any sections in the district considered. Extra high-potential wires (over 5,000 volts) in any occupied part of the city is considered a menace to fire fighting. Deficiency in these features is to be applied in proportion to seriousness of general conditions.

c. For seriousness of overhead wire obstructions in the district considered:

Use ⅕ Deficiency Scale.

d. For the amount and condition of overhead high-potential (over 600 volts) wiring in the district considered:

Use 1/10 Deficiency Scale.

e. For the amount and condition of overhead extra high-potential (over 5,000 volts) anywhere in the municipality:

Use 1/10 Deficiency Scale.

33. BUILDING INSPECTIONS.—Systematic and frequent inspections shall be made by company and department officers to acquaint them with local conditions and records of such inspections shall be kept both by notes and sketches.

a. Fair.	**5**
b. Poor.	**10**
c. Very Poor.	**20**

34. RECORDS.—Proper records of all fires, fire methods, losses, apparatus and all department matters shall be kept.

a. Fair.	**5**
b. Poor.	**10**
c. Very Poor.	**15**

FIRE ALARM SYSTEM.

Note.—Items 1 to 20, inclusive, to apply to a municipally owned or controlled telegraph system for receiving and transmitting alarms of fire. Items 21 to 24 are to apply to the auxiliary service furnished by telephone. Where fire stations are not connected by fire alarm telegraph circuits, a total deficiency of 350 points shall be applied and additional points debited for deficiencies in such telephone system as is available, under Items 3 and 4 and Items 21 to 24, inclusive; credit to be given under Item 18, for street telephones accessible to the public, to the extent of ½ the credit for municipally owned fire alarm boxes, with deficiences under Items 16, 17 and 19 applied.

1. Qualifications of Management.—Management to be experienced and qualified.

Not qualified:

Use 1/10 Deficiency Scale.

2. Maintenance Force.—Force to be adequate for maintenance or good provision for obtaining emergency help, and to be competent.

Maintenance force inadequate or incompetent:

Use 1/10 Deficiency Scale.

3. Operators.—Operating force shall consist of some competent person, controlled by the municipality, but not necessarily at fire alarm headquarters, on duty at all times to handle telephone alarms; provided that in municipalities of less than 10,000 population ½ credit, and in larger cities ¼ credit, may be given for a telephone operator on duty at each public exchange at all times, with facilities for transmitting coded signals giving the location of the fire. In cities handling an average of over one alarm a day a fire alarm operator shall be on duty at fire alarm head-

Points

quarters, and when manual operation is depended upon for transmission of alarms, two operators shall be on duty at all times. An operator of the telephone system, if capable of operating the fire alarm system, may be considered as one fire alarm operator.

Where practically all telephone alarms are transmitted to some fire station, and some member of the company is detailed to handle telephone alarms, but is not left on duty when apparatus goes out, a deficiency would apply, ranging from 25 to 50 per cent. If night watch is not maintained at the point where telephone alarms are received, an additional deficiency might apply.

Operating force inadequate or incompetent:
Use ⅕ Deficiency Scale.

4. HEADQUARTERS.—Apparatus on which operation of the system and the receipt and transmission of alarms are dependent, to be housed securely against fire, including danger from conflagration. When service is dependent entirely upon the telephone exchange, application shall be made to the exchange building. Combustible material to be a minimum in mountings, etc.

a. Headquarters non-fireproof.	**15**
b. " exposed and not protected.	**15**
c. Internal hazards severe.	**10**
d. No private fire protection in apparatus rooms.	**5**

5. APPARATUS AT HEADQUARTERS.—To be such as to ensure receipt, recording and transmission of all alarms and to be in good condition. Systems having more than 400 alarms a year or needing 17 or more box circuits, shall have provision permitting transmission manually; if automatic transmission is also provided, means must be provided for cutting out the automatic feature. Relative values of headquarters equipment is as follows:

Automatic System: Repeating mechanism, 50 per cent.; mechanical transmitting apparatus, 20 per cent.; switchboard, 15 per cent.; register, 10 per cent.; cable terminal, 5 per cent.

Points

Manual System: Receiving apparatus, 25 per cent.; transmitting apparatus, 25 per cent.; recording apparatus, 15 per cent.; control board, 15 per cent.; testing facilities, 15 per cent.; cable terminal, 5 per cent.

In automatic systems, registering device and means of manual transmission of alarms need not be at fire alarm headquarters, but must be where telephone alarms are received. Telephone service not to be considered under this Item; see Items 21 and 24.

a. For incomplete apparatus at headquarters:
Use ¼ Deficiency Scale.
b. For poor condition add 1/10 Deficiency Scale.

6. CIRCUIT PROTECTION.—To consist of: For each entering conductor at headquarters, a heavy current fuse, lightning arrester, and sneak current fuse; near battery terminals, heavy current fuses; for conductors entering buildings from aerial lines, a lightning arrester; at junction of aerial open lines with cable, for each conductor a lightning arrester and a 5-ampere fuse.

Circuit Protection:

a. Fair	**5**
b. Poor.	**10**
c. Very poor.	**20**

7. BATTERIES.—Storage batteries in duplicate or generator sets with sufficient reserve, properly mounted in a well heated and ventilated room, separate from other apparatus; in single-circuit systems, suitable primary batteries may be used. Provision shall be made for obtaining a duplicate source of supply within 2 hours. Charging shall be normally from an all-metallic circuit and shall preferably be current of not over 250 volts.

a. Poor type of mounting.	**10**
b. Insufficient.	**10**
c. Not well maintained.	**5**
d. No provision for duplicate source of current.	**5**
e. Charging normally from grounded circuit.	**5**

Points

8. CIRCUITS.—All circuits shall be underground; box circuits serving fire stations count as alarm circuits and shall be applied under both *a* and *b* below.

a. Use 1/10 Deficiency Scale for box circuits.
b. Add 1/10 Deficiency Scale for alarm circuits.

9. CONDITION AND MATERIALS OF CIRCUITS.—Circuits in underground and aerial cable shall be copper wire with rubber insulation in lead sheath; for underground wire to be not less than No. 12 Gage for single conductor, not less than No. 14 for two or three conductors, not less than No. 16 for four or more conductors; for aerial cables not less than No. 16 Gage. Aerial single wires to be not less than No. 10 Gage copper or No. 12 Gage copper-clad steel, with double- or triple-braid weatherproof insulation. Poles to be substantial and wires and cables, including box leads, to be well supported and protected. The running of circuits into buildings other than fire stations introduces a hazard.

Use ⅕ Deficiency Scale.
With good underground construction in high value districts, use 1/10 Deficiency Scale for condition of overhead elsewhere.

10. CIRCUITS NEAR HIGH-POTENTIAL.—Circuits shall not be in same duct or manhole nor on same pole with high-potential circuits.

Circuits on poles or in manholes with high-potential circuits.
a. Few. 5
b. Many. 10

11. OPEN OR GROUNDED CIRCUITS.—All box and alarm circuits must be normally closed, all-metallic, and under constant test. Local circuits at headquarters and at fire stations, on which the receipt or transmission of alarms is dependent, shall be normally closed or in duplicate, and application shall be made in proportion to the number of instruments affected, unless sufficient instruments on normally closed circuits are provided to ensure receipt or transmission.

Normally Open Circuits: **Points**

a. For each 10 per cent. of instruments at fire stations controlled by open alarm circuits or open local circuits, either at headquarters or fire stations. **2**

b. For each 10 per cent. of boxes whose receipt is controlled by open line circuits or open local circuits not in duplicate at headquarters. **2**

Ground return:

c. For each 10 per cent. of stations affected. **1**

d. Add for each 10 per cent. of boxes affected. **1**

12. CIRCUITS OVERLOADED.—Not more than 20 boxes shall be dependent upon any box circuit; except for circuits entirely underground 30 boxes may be permitted. Only boxes, and in an automatic system, registers and sounding devices in fire stations, may be connected to box circuits. No alarm circuits shall connect instruments in more than 5 fire stations.

a. Use 1/10 Deficiency Scale for box circuits.

b. Add 1/20 Deficiency Scale for alarm circuits.

Note.—Do not apply in single circuit systems, where deficiency has been applied under Item 5, for lack of a repeater. In automatic system, if no alarm circuits are provided, do not apply under b unless more than 5 stations are on any one box circuit.

13. CIRCUITS TO AND APPARATUS IN FIRE STATIONS.—Except where only a single circuit system is required, each fire station must receive alarms over two alarm circuits; in an automatic system some box circuit shall extend to each fire station, and each box circuit shall extend to some fire station; such circuits may count as one of the required alarm circuits. Fire station apparatus shall include a register and sounding device on the primary alarm or box circuit, and a sounding device on the secondary alarm circuit, with means for transferring the register to the secondary circuit. Telephone apparatus not to be considered under this item.

Points

a. For deficient circuits to fire stations:
Use 1/10 Deficiency Scale.
b. And add for deficient apparatus:
1/10 Deficiency Scale.

14. INSIDE WIRING.—Wiring of fire alarm circuits in buildings shall be in conduit or in plain sight; circuits shall enter buildings in conduit. Wiring to be in accordance with the National Electrical Code.

a. Use 1/10 Deficiency Scale for Headquarters.
b. Add 1/20 Deficiency Scale for station wiring.

15. BOXES.—Boxes, including private boxes, shall be non-interfering and succession, except: In a non-repeating system, with one box on the circuit, or in a manual system with not more than 10 boxes on such circuit in a limited area, interfering boxes may be permitted; in a single circuit system, having more than one box, they need not be succession.

a. Use 1/10 Deficiency Scale for interfering boxes or boxes of poor design.
b. Add 1/20 Deficiency Scale for non-succession boxes.

16. CONSPICUOUSNESS AND ACCESSIBILITY OF BOXES.—Public boxes and private boxes accessible to the public shall be conspicuous as applying to location and designation, and including red lights at night on or close to all boxes in high value districts; they shall be provided with door having glass or other suitable protection for operating or opening device or with keyless single-acting door.

For conspicuousness:
a. Use 1/20 Deficiency Scale for high value district considered.
b. Add 1/20 Deficiency Scale for other districts.
c. Add for each 10 per cent. not adapted to prompt turning in of alarms. 1

17. CONDITION AND TESTS OF BOXES.—Boxes shall be maintained in good operative condition. They shall be tested monthly and after electrical storms; tests to include visual inspection, operation, cleaning and repairing;

Points

condition of boxes shall be used in judging of thoroughness of tests.

For condition of boxes and adequacy of tests:
Use 1/10 Deficiency Scale.

18. BOX DISTRIBUTION.—Proper distribution of boxes requires a public box, or a private box accessible to the public, within at least 500 feet of every building in mercantile and manufacturing districts, and 800 feet of every important group of buildings elsewhere.

For numerical deficiency of boxes:

a. Use ½ Deficiency Scale for high value district considered.

b. Add ⅕ Deficiency Scale for other districts.

19. TESTS AND RECORDS (Except box-tests).—Circuits at Headquarters to be tested 4 times daily in manual systems, twice daily in automatic repeating systems and at least once daily in automatic non-repeating systems; also frequently in wind and electrical storms; tests to be for current strength, voltage, grounds and continuity. Insulation resistance of all cable conductors to be measured weekly. Battery cells to be tested for voltage and electrolyte, weekly. Circuits to be examined monthly and after wind or sleet storms. Complete records to be kept of tests, of apparatus and layout of systems, and of all troubles. Condition of system to be used in judging of thoroughness of tests.

a. For frequency and adequacy of tests:
Use 1/20 Deficiency Scale.

b. For Records, add 1/20 Deficiency Scale.

20. SPEED OF ALARMS.—Speed of boxes and of alarm transmission shall not be less than 1 stroke per second in automatic and 2 strokes per second in manual systems. Tower bells, if necessary, to be operated on separate circuits, so as not to delay the operation of the system.

Speed of Alarms:

a. Slow.	**5**
b. Very slow.	**10**

TELEPHONE SERVICE.

21. There shall be connected a telephone at each fire station by a single party line, preferably from some central points where a municipally controlled operator is on duty at all times; for cities having more than 5 fire stations, these shall extend from a private switchboard. Provisions shall be made permitting stations to be communicated with simultaneously or in groups.

For Fire Department Telephone System:

Use ⅕ Deficiency Scale.

22. Telephone alarms shall be transmitted from the public exchange to the same place in all cases and not to any fire company called nor to all fire stations simultaneously; they shall be transmitted to all fire stations as coded signals after notifying the nearest company by telephone. The sounding of ward or box numbers on tower bells or equivalent mechanism is sufficient, in towns up to 5,000 population having call or volunteer fire departments.

For Transmission of Telephone Alarms:

Use 1/10 Deficiency Scale.

23. At least one circuit from the telephone exchange shall be reserved for fire calls, and exchange operators shall be instructed in transmitting emergency calls.

For provisions for transmitting telephone fire alarms from the telephone exchange:

Use 1/10 Deficiency Scale.

24. At the public exchange, the supervising operator or other responsible employee shall verify the location and oversee the transmission of fire alarms.

For method of handling telephone fire alarms at the telephone exchange:

Use 1/10 Deficiency Scale.

POLICE.

Points

From the standpoint of fire protection, the duties of the police are the discovery of fires and the sending of alarms, the preserving of order at fires, and the reporting of buildings under construction without permit. Adequate service requires a proper signalling and/or telephone system.

Municipalities of less than 2,000 population should have a watchman on duty at night in the mercantile district; for over this population there should be an adequate number of patrolmen on duty day and night, and if over 15,000 population, sufficient wagons and ropes and a signalling system should be provided.

1. Co-operation with fire department:	
a. Fair.	**10**
b. Poor.	**20**
2. Insufficient wagons: (1 for each precinct station is considered sufficient.)	**10**
3. No signalling nor telephone system.	**10**
4. Cooperation with building department poor.	**10**

Note.—Where no police force or watchman is maintained, but is required, grade Items 1 and 4 as poor; if a Fire Police force is maintained, do not consider Items 2 and 3, and use ½ deficiency under Item 1.

BUILDING LAWS.

Points

Adequate building laws, either State or Municipal, shall be enacted. There shall be prescribed fire limits, including all closely built mercantile and adjoining manufacturing districts and surrounding blocks on all sides which constitute an exposure to the district or within which new construction of a mercantile or manufacturing character is developing; within these limits, frame construction shall be prohibited. Proper restrictions shall be made for heights and areas, requirements for protection to vertical and horizontal openings of all kinds, thickness of walls, private fire protection, chimneys and heating devices, etc., as given in the National Board Building Code. Fire-resistive roof coverings shall be required throughout the municipal limits. A properly qualified official shall be in charge, with a requisite number of assistants. Proper records of building permits and operations and inspections shall be kept.

Note.—When enforcement of laws relating to any of Items 1, 2 or 3 is inadequate, grade for deficiency as for inadequate laws; the total under any subitem for both lack of requirement and lack of enforcement not to exceed the points given.

1. Fire limits: For each 10 per cent. of area inadequate.	**5**
2. Laws in regard to the following subjects inadequate or not enforced:	
a. Heights.	**10**
b. Areas.	**10**
c. Protection to exposed windows.	**10**
d. " " vertical openings.	**10**
e. " " communications through fire walls.	**8**
f. Frame construction in fire limits.	**10**
g. Wall thicknesses.	**10**
h. Chimneys and heating apparatus.	**10**
i. Improved construction.	**5**
j. Private fire protection.	**5**

	Points
k. Provisions for fire stops.	5
l. " " fire escapes.	2
m. " " parapets.	3
n. " " quality of materials and workmanship.	2
Total	100

3. Fire-resistive roof coverings not required: For each 10 per cent. of area of the city. 4

Omit farm lands or other territory not subject to building operations; use as basis approximately the area covered by water distribution system.

4. Records:
   - a. Poor. 5
   - b. None. 10

HAZARDS.

Points

The passage of laws, either State or Municipal, on the subject of electricity, explosives and inflammables, and proper enforcement of such laws, produce immediate results. The National Electrical Code is the generally recognized standard for electric wiring. Its adoption by ordinance is of first importance; the laws should also provide that current shall not be furnished until the installations have been inspected and approved. The results may be obtained through enforcement by a properly qualified official, or under insurance inspection backed by a city ordinance.

Where electricity is not generally used, the hazards of glass body oil lamps, swinging and open gas flames, natural gas at high pressure, and of gasoline and acetylene lighting system are usually present. In addition to applying to these, the laws should cover other uses of inflammable liquids and their compounds, explosives of all kinds and the care of combustile rubbish of all kinds. Requirements should conform to the suggested ordinances and regulations issued by the National Board of Fire Underwriters. Enforcement shall be strict, and frequent inspections shall be made; the most approved method of inspection is through the members of the fire department.

Note.—Under Items 1 to 7, inclusive, application shall be made in proportion to the general use of each of the three principal forms of lighting and heating, on the basis of a possible maximum of 100 points.

ELECTRIC LIGHTING AND HEATING—

1. Laws:

a. Slightly inadequate.	**5**
b. Moderately inadequate.	**10**
c. Very inadequate or none.	**20**

Note.—If National Electrical Code is not enacted, but is enforced by ruling of the inspector, grade not better than "Moderately inadequate". If enacted, but not enforced, grade as for inadequate laws.

	Points
2. New inside work:	
a. Fair condition.	**5**
b. Poor condition.	**15**
c. Very poor condition.	**30**

Note.—To be judged from condition of installations. Where municipality does not exercise control and there is no agreement between underwriters and local electric light company, grade not better than "Poor".

3. Old inside work:	
a. Fair condition.	**10**
b. Poor condition.	**25**
c. Very poor condition.	**50**

If reinspections are being made, use ½ points.

OIL LIGHTING AND HEATING (Including Gasoline, Kerosene and Alcohol lamps and systems).—

4. Laws:	
a. Slightly inadequate.	**5**
b. Moderately inadequate.	**10**
c. Very inadequate or none.	**20**

5. Condition:

Use ⅕ Deficiency Scale.

GAS LIGHTING AND HEATING (Including Acetylene).—

6. Laws:	
a. Slightly inadequate.	**5**
b. Moderately inadequate.	**10**
c. Very inadequate or none.	**20**

7. Condition:

Use ⅕ Deficiency Scale.

EXPLOSIVES AND INFLAMMABLES.—Laws deficient or not enforced.

When enforcement of the laws relating to any of the following sub-items, except as already considered in Items 1 to 7 above, is inadequate, grade for deficiency as for inadequate laws, the total under any

	Points
sub-item for both lack of requirement and lack of enforcement not to exceed the points given.	

Where very inadequate or no laws, but inspections are made, apply deficiency according to conditions found, but not less than ½ the points for each sub-item.

8. Laws deficient or not enforced as affecting:	
a. Inflammable Liquids of Class I.	20
b. " " " " II.	15
c. " " " " III.	5
d. Hazardous Chemicals.	10
e. Carbide.	5
f. Garages.	15
g. Dry Cleaning.	15
h. Nitro-Cellulose and Films.	15
i. Motion Picture Machines and Booths.	5
j. Explosives.	20
k. Fireworks.	5
l. Matches.	5
m. Combustible Fibres, etc.	10
n. Lumber and Packing Materials.	5
o. Rubbish, Trash, Ashes, Bonfires, etc.	20
p. Definite requirement for Inspection of Premises.	10
Total	180
9. Records:	
a. Poor.	10
b. None.	20

STRUCTURAL CONDITIONS.

This schedule is designed to be applied to any mercantile or manufacturing district; in the smaller cities it is to be applied to the principal mercantile district, but in larger cities a separate grading may be desirable for each distinctive high value district. All items apply only to the district considered.

In bounding a district, streets and alleys, sometimes extended, railroads and natural features will be used where practicable and every block or part block shall be included in which approximately ⅓ of the area is of the same general class as the district.

Where district bounds are taken as "blank" feet back of a street front and there is considerable open space back of the buildings, include as in the district approximately 50 feet back of the buildings, but not to exceed ½ the distance to the nearest buildings.

Wharf district boundaries to extend from end of pier to end of pier, where piers are continuous along the water front, and slip area to be counted as open area.

Narrow streets, inaccessibility of buildings, congestion of the district and of the individual blocks, poor general structural conditions and exposures from surrounding sections all increase the probability of sweeping fires.

Buildings of fireproof construction, sprinklered brick buildings, fire breaks, fire barriers and, where there is also a domestic system furnishing hydrant supply, separate high pressure fire system designed to deliver capacity at 90 pounds hydrant pressure or more, form important mitigating features.

Under Items 6, 8, 9 and 10, in determining the number of buildings, exclude sheds and additions and buildings of less than 300 square feet area, except that two or more such buildings may be counted as one building if adjoining and totaling over 300 square feet area.

Structural Conditions.

Points

Consider lumber or wood storage as frame construction and assume passageways as breaking up the area.

1. Area of District (or largest subdivision).—An undivided area increases somewhat the possible extent of a sweeping fire. Fire breaks and barriers subdividing a district will include: Rivers, parks, streets, railroad tracks, unoccupied territory, railroad embankments and similar structures, and groupings of mutually supporting fireproof or sprinklered structures which effectively subdivide a district. Fire breaks to be recognized as effectively subdividing a district shall have a total width of at least 150 feet.

Area of District or of Large Subdivisions:

400 acres or more	50
300 "	30
200 "	20
100 "	10
50 "	4
10 "	0

2. Street Widths in District.—A through passageway, more than 20 feet in width, shall be considered as a street. Total length of streets not to include bounding streets.

Where buildings are uniformly set back of the street line, the width of street may be assumed as distance from building front to building front.

a. For each 10 per cent. of total length 50 feet wide or less.	5
b. Add for each 10 per cent. of total length under 80 feet wide.	5

Do not apply b if no deficiency under Items 6 b or e.

3. Accessibility of Blocks.—A block shall be considered inaccessible if more than 50 per cent. of the number of buildings have only one side accessible from a street, alley, driveway or courtyard and other open spaces readily acces-

Points

sible from the street. All streets, as defined under Item 2, shall be considered as forming block boundaries.

For per cent. of blocks inaccessible:
Use 1/10 Deficiency Scale.

4. PER CENT. OF AREA OF DISTRICT IN STREETS AND OPEN SPACES WHICH CANNOT BE BUILT UPON, INCLUDING ONE-HALF WIDTH OF BOUNDING STREETS:

50 per cent. or over	0
40 per cent.	20
30 per cent.	50
20 per cent.	90
10 per cent.	130

5. PER CENT. OF BLOCK AREA (INCLUDING ALLEYS) BUILT UPON:

0 per cent.	—140
10 per cent.	—100
20 per cent.	— 70
30 per cent.	— 40
40 per cent.	— 20
50 per cent.	0
60 per cent.	10
70 per cent.	20
80 per cent.	35
90 per cent.	50
100 per cent.	70

Where less than 50 per cent. of the block is built upon, the lack of congestion is considered as below normal and credit or minus points of deficiency are allowed.

6. HEIGHTS OF BUILDINGS.—Buildings on side hill, use as height of the building the maximum height on a street front, but not alley front.

Note.—Sub-items a and d below do not apply where the Water Department and Fire Department combined total less than 2,200 points.

a. Frame buildings 2 and 3 stories high.

For per cent. of total number of buildings:

Use ½ Deficiency Scale, but deduct from the points of deficiency 10 per cent. for each 100

points that the Water Supply and Fire Department combined are less than 3,200 points.

b. Frame buildings 4 stories and over:

For per cent. of total number of buildings, use 2 times Deficiency Scale.

c. Frame buildings 6 stories and over:

For per cent. of total number of buildings, add 4 times Deficiency Scale.

d. Non-fireproof buildings (except frame) 2 to 4 stories high.

For per cent. of total number of buildings:

Add ¼ Deficiency Scale, but deduct from the points of deficiency 10 per cent. for each 100 points that the Water Supply and Fire Department combined are less than 3,200 points.

e. Non-fireproof buildings (except frame) 5 stories and over:

For per cent. of total number of buildings, add full Deficiency Scale.

f. Non-fireproof buildings (except frame) 7 stories and over:

For per cent. of total number of buildings, add full Deficiency Scale.

7. LARGE AND EXCESSIVE AREAS (other than frame), but including communicating areas without standard (double fire doors) protection:

If communicating brick and frame buildings combined exceed 5,000 square feet, apply the brick area and the frame area separately, but under the sub-item corresponding to the total combined area. Apply similarly for other combined areas of different classes of construction, making a charge under the sub-items corresponding to the total combined area.

When sprinklers protect the principal hazard, and basement if any, but not all stories, credit not more than 50 per cent. of building area as sprinklered.

a. Unsprinklered non-fireproof areas exceeding 5,000 square feet and unsprinklered fireproof areas or sprinklered non-fireproof areas exceeding 10,000 square feet:

For per cent. of total built-on area, use ½ Deficiency Scale.

Points

b. Unsprinklered non-fireproof areas exceeding 10,000 square feet and unsprinklered fireproof areas or sprinklered non-fireproof areas exceeding 20,000 square feet:

For per cent. of total built-on area, add full Deficiency Scale.

c. Unsprinklered non-fireproof areas exceeding 20,000 square feet and unsprinklered fireproof areas or sprinklered non-fireproof areas exceeding 40,000 square feet:

For per cent. of total built-on area, add full Deficiency Scale.

8. PARTY AND FIRE WALLS, OR EXTERIOR WALLS WITHOUT OPENINGS.—When of standard thickness, as given in the National Board Building Code, with proper parapets and cut-offs at cornices, party and fire walls at frequent intervals in otherwise continuous block fronts lessen the danger of the spread of fire from building to building, provided such walls are in good condition.

In frame section or rows, compliance with the National Board Building Code, Sec. 188, paragraphs 4 and 6, and Sec. 190, paragraph 1, will be considered as the equivalent to fire walls.

a. Frequency of party and fire walls in proportion to total number of buildings.

Large number.	**0**
Considerable number.	**10**
Moderate number.	**25**
Small number.	**50**
None.	**80**

b. Thickness:

Few thin.	**5**
At least one-third 4 inches deficient in some part.	**10**
At least one-third 8 inches deficient in some part.	**20**

Note.—Do not apply for deficiency in thickness where application was made for a Small number under a.

c. Condition, including parapets and exterior walls:

Fair.	**10**
Poor.	**20**

Points

9. FLOOR OPENINGS.—Standard protection shall be provided on all communications between stories. Consider as protected all frame, all 1-story brick buildings, and all 2-story brick buildings where stairs are cut off from first floor by partitions approximately equal to the floor in fire resistance.

Buildings, other than frame, with unprotected openings:

For each 10 per cent. of total number of buildings. 5

10. EXPOSED OPENINGS.—Openings in exterior walls, if exposed within 50 feet, shall be protected in a standard manner:

Buildings, other than frame, with openings exposed and not protected:

For each 10 per cent. of total number of buildings. 8

11. FRAME AREAS:

a. Frame areas of all sizes, including sheds and porches:

For per cent. of total built-on area, use full Deficiency Scale.

b. Unsprinklered frame areas exceeding 5,000 square feet and sprinklered frame areas exceeding 10,000 square feet:

For per cent. of total built-on area, add full Deficiency Scale.

c. Unsprinklered frame areas exceeding 10,000 square feet, and sprinklered frame areas exceeding 20,000 square feet:

For per cent. of total built-on area, add full Deficiency Scale.

d. Unsprinklered frame areas exceeding 20,000 square feet, and sprinklered frame areas exceeding 40,000 square feet:

For per cent. of total built-on area, add twice Deficiency Scale.

12. PERMANENT AWNINGS AND COMBUSTIBLE ROOFS:

a. For per cent. of street frontage covered with permanent awnings:

Use 1/10 Deficiency Scale.

Points

b. For per cent. of buildings with non-fire-resistive roof coverings:
Use ½ Deficiency Scale.

13. CONFLAGRATION BREEDING BLOCKS.—When blocks in a district have a hazard distinctly greater than normal for the district, and are grouped, that is, the separating space is less than 100 feet, a deficiency shall be applied.

For each block in groups of two or more adjoining blocks.	**5**

14. EXPOSURES TO DISTRICT.—In considering exposures, the prevailing direction of winds and the prevalence of frame construction and wooden shingle roofs in the exposing sections and the linear extent of the exposure must be taken into account. Consider each of the four sides of the district separately. When the district under consideration is subdivided by fire breaks or barriers, apply exposures of the largest subdivision.

a. Mild exposure.	**5**
b. Moderate exposure.	**10**
c. Severe exposure.	**15**
d. Very severe exposure.	**20**

Add points of exposure of the four sides.

CREDITS.

21. SUPERIOR CONSTRUCTION AND PROTECTION:

	Points
a. For each 2 per cent. of built on area covered with fireproof.	**5**
b. For each 2 per cent. of built on area covered with sprinklered construction (other than frame).	**5**

22. Where full fire flow is available as direct hydrant streams, either from the domestic system or from a high pressure system, the maintaining of engines in service with adequate provision for their response and operation, is considered an advantage as reducing the probability of a fire gaining headway in the interval of time necessary to control the flow from a broken main, and credit shall be allowed accordingly.

For each 10 per cent. of required engine capacity available, based on ⅔ fire flow required, reduce points of deficiency 1 per cent. (after deducting Item 21).

23. HIGH PRESSURE FIRE SYSTEM.—A high pressure fire system may have gravity supply, direct pumpage supply or a combination of the two. It may be a separate system for fire service only, or may be the extension of a High service domestic supply into a Low service area, in which latter case only ⅔ the actual fire flow obtained shall be assumed as available capacity. Fire boat pipe lines shall also be considered, the probability of the boats not being available being graded under Item 7. For emergency service of fire boats to systems having other source of supply, credit shall be given only under reliability (Items 7 to 17, inclusive) and for only ½ the points which this supply decreases the deficiency of the system.

To be standard, a high pressure fire system must comply fully with the various items listed hereinbefore under Water Supply and be capable of delivering in the weakest part of the system the full fire flow required by the table on page 14, including that necessary for a second fire; such supply to be

available in an area equal to that served by the number of hydrants necessary to deliver this required fire flow when discharging 1,000 gallons a minute each. For standard fire service this quantity shall be available at a residual pressure of 250 pounds; residual pressures less than this, down to 90 pounds as a minimum, permit classing a system as a High Pressure Fire System, but of less worth in reducing the deficiencies in Structural Conditions. Hydrants to be of ample dimensions, with 4 independently gated hose outlets and with 8-inch gated connections to the mains; to be so distributed that the entire area of the district is protected and the average area served per hydrant shall not exceed 40,000 square feet.

For each 10 per cent. of combined adequacy and reliability of the High Pressure Fire System, deduct a percentage of the total points under Structural Conditions (after deducting Item 21) on the following basis:

For fire flow available at 250 pounds, 7.5 per cent.; for fire flow available at 200 pounds, 6.5 per cent.; for each 10 pounds under 200 pounds pressure, down to 90 pounds, at which fire flow is available, use a percentage 0.5 less.

Where the piping system is dry during a part of the year, only ½ the above percentage of credit will be allowed.

Note.—The value of a High Pressure Fire System to be determined on the basis of fire flow; when the system furnishes supply for other than fire purposes, fire flow shall be considered as the amount available after allowing for such other uses. The system shall be graded on the basis of a possible total deficiency of 1,000 points, application being made as under Water Supply, except as modified below:

Item 5.—Use ⅕ Deficiency Scale for means of notification of repair gang, competent officials and any pumping station.

Item 6.—a and b to be based on maximum quantity available in the district at the weakest point in

the system, whether due to poor gridironing or elevation.

a. For fire flow at time of average domestic consumption:

Use 2 times Deficiency Scale.

b. For fire flow at time of maximum domestic consumption:

Use ½ Deficiency Scale.

c. Not to be applied.

Item 16.—To be for maximum effect on fire flow at the same pressure used under Item 6 a and b.

Items 20, 21, 22, 23, 26 c and d, 29 and 31 b.—Not to be applied.

Under each item the application must include any additional points due to deficiency of the plant furnishing power.

Per cent. of combined adequacy and reliability

$$= \frac{1{,}000 - \text{points of deficiency}}{1{,}000}$$

ADDITIONAL DEFICIENCIES.

Points

ADVERSE CLIMATIC CONDITIONS.—Items 1, 2, 3 and 4 to be based on average conditions for at least a 10-year period, if available. Where no weather bureau station is located in the city, use the average for the closest two or three stations.

1. WINDS of 25 miles velocity or over:

   For each 4 times yearly in excess of 60 times per year. 1

2. SNOWFALL in excess of 10 inches per month:

   For each month per year. 5

3. SEVERE COLD WEATHER:

   Apply only for the months having an average of 10 days or more with a maximum temperature of 32 degrees.

   For each day having a maximum temperature of 32 degrees or less. 1

4. HOT DRY WEATHER:

   Apply for the months having an average mean maximum temperature of 65 degrees or more, with 6 or less days of .01 inch or over of precipitation. Deficiency to be based on the formula

$$\frac{m\ t^2}{150\ d} = \text{Points of deficiency.}$$

   m = Average number of months per year.

   t = Average monthly mean maximum temperature.

   d = Average number of days per month with .01 inch precipitation.

5. UNUSUAL OR EXCEPTIONAL CONDITIONS.—Apply for conditions not measurable by the climatic conditions above,

which offset protection and increase the probability of starting fires: These to include frequency and extent of forest fires which might extend into the city; tornadoes, hurricanes and cyclones which result in numerous fires or interruption of fire service; blizzards and severe snow storms which impede operation of the fire department; earthquakes of such intensities as to injure buildings, water mains and cause numerous fires; mine cave-ins affecting extensive areas, and floods which cover part of the district considered or cause wide detours of fire apparatus.

On the basis of numbers; one each 10 years shall be classed as seriously frequent, and one each 20 years moderately frequent; the extent or effect of the conditions shall increase or decrease this proportionately.

Use 1½ times Deficiency Scale.

DIFFERENCE IN GRADING OF WATER SUPPLY AND FIRE DEPARTMENT.—Where the fractional classes corresponding to the points of deficiency of the water supply and fire department, that is, the points of deficiency divided respectively by 170 and 150, differ by 3 classes or more, there shall be added to the total points of deficiency a certain number of points varying with the amount of divergence between the classes of the two features. The number of points to be added shall be determined by the following table, proportioning for fractional divergence in classes:

Divergence in Classes.	Additional Points of Deficiency.
3	45
4	90
5	150
6	225
7	315
8	420
9	540
10	680